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ANTHRACNOSE AND MOTTLE LEAF OF CITRUS IN WESTERN AUSTRALIA.

By

H. A. Pittman, B.A., B.Sc.Agr., Dip.Ed.,
Plant Pathologist;

and

Ray C. Owen, B.Sc. (Agr.),
Agricultural Adviser.

For the past eight years or so, the disease known as Anthracnose (*Colletotrichum gloeosporioides*) has been gradually increasing in importance on various kinds of citrus trees grown in this State. When it first began to occasion concern, it appeared to be restricting its attention almost entirely to navel oranges, on which it was responsible, in addition to leaf and twig injuries, for the development of a dark brown discolouration in the skin of the fruit at the stem-end, whence the local name, "Stem-end Browning" (6).

As time has gone on, it has been found that the same disease has been gradually increasing in importance as a cause of defoliation of orange and other citrus trees, such as lemons, mandarins, and grape fruits, and has been the cause of a considerable amount of dying back of twigs and small branches. Whereas the Brown Rot diseases (*Phytophthora citrophthora* and *P. hibernalis*) cease to cause any further injury to the trees with the advent of hot, dry weather (6, 7), the Anthracnose disease may continue to cause defoliation during the summer months. Affected leaves become brown at the tips, curl round towards the mid-rib and eventually fall off.

In the case of Valencia orange fruits, the Anthracnose fungus seems rarely to attack the fruit directly, but it is becoming increasingly important as a cause of mummification of such fruits while still hanging to the trees. This is brought about by the fungus attacking and killing the fruit stalk, so that the supply of sap to the fruit becomes gradually cut off. In other instances the Anthracnose fungus has been found affecting lemon fruits, causing peculiar scratchy-like brown or blackish markings on the skin which may or may not be thrown into a number of small elevations at the sites of the discoloured markings. On the fruits of lemons, the Anthracnose trouble has so far only been found where the trees have been over-irrigated with sprinklers during the summer months, or where moisture has been blown on to the trees, during this period, by the winds, from leaking overhead windmill tanks.

Whereas the Brown Rot diseases have proved themselves very amenable to control by preventive spraying with Bordeaux Mixture (6, 7), the Anthracnose disease cannot be so readily controlled. As a matter of fact, it would appear, as has been found the case in America (4), that the control of this disease depends rather more on the building-up of the general health of the tree, than on the use of fungicidal sprays, although the value of these when combined with other measures designed to put the trees in a vigorous state of health should not be under-estimated (6).

MOTTLE LEAF OF CITRUS.

During investigations into the increasing prevalence and seriousness of the Anthracnose disease in Western Australia, which have been carried out during the past few years as opportunity permitted, it has been observed that another trouble which has also been present in many of our citrus orchards for a considerable period is also becoming more prevalent. This trouble is that known as "Mottle Leaf."

Fig. 1.—An orange tree at Maddington, showing the combined effects of the non-parasitic disease "mottle-leaf," and the anthracnose disease caused by the fungus *Colletotrichum gloeosporioides*. Although the mottling of the foliage does not show in the photograph, the lack of density in the tree caused by the absence of crop, the small size of the majority of the leaves and the great abundance of dead leafless twigs can be appreciated, especially by comparison with the healthy tree on the right.

Photo. by the authors.

Whether or not the increasing importance of the Anthracnose disease is definitely correlated with the increasing development of Mottle Leaf (or incipient Mottle Leaf) has not actually been conclusively proved, but observation suggests very strongly that this is the case. Certainly the development of the Mottled Leaf condition indicates that the trees are not in the best possible state of health from a nutritional point of view; and there are few of our citrus trees of 15 years or more of age on which this disease is not, to a greater or less extent, present.

In an attempt to overcome the Mottled Leaf condition with its associated die-back and reduction in productivity, several experiments have been carried out by the authors in collaboration, on citrus and apple trees affected with mottled leaves.

The general technique used was to dip branches bearing mottled leaves into 1 per cent. aqueous solutions of the following chemicals, viz.:—Copper sulphate, magnesium sulphate, iron sulphate, potassium sulphate, chromium sulphate, zinc sulphate, manganese sulphate and aluminium sulphate. No appreciable improvement was, however, found as a result of these tests, which were only regarded as preliminary, and which were not carried out under very favourable conditions.

Following on the work which has been done of recent years in the United States of America, by various workers, using sulphate of zinc and other zinc compounds as spray materials, or as dressings for the soil, in the case of trees affected with Mottle Leaf or with Little Leaf (1, 2, 3, 5), it was decided to try the effect of spraying certain trees in the Maddington area, W.A., which were badly affected with Mottle Leaf, with sulphate of zinc.

SPRAYING EXPERIMENTS WITH SULPHATE OF ZINC.

On the 27th of October, 1935, therefore, the second-named author sprayed six very badly mottled Valencia and navel orange trees with a 1 per cent. solution of chemically pure sulphate of zinc in water, using 1½ gallons of the solution per tree. A number of similarly affected trees in the vicinity were left as general controls, two of these being treated as specific control trees. When the trees were examined six weeks later a very definite change in the appearance of the sprayed trees, for the better, was noticed. Considerable new growth had developed, and the chlorotic or mottled appearance was no longer manifest. The specific and general control trees did not show any signs of new growth at this date, and their chlorotic condition remained unchanged. As a matter of fact the control trees showed no signs of new growth until January, 1936. When they did develop new shoots these were, as usual, markedly chlorotic.

At the same date as the six trees referred to above were sprayed all over, another tree was sprayed with 1 per cent. sulphate of zinc on one side only. Six weeks later this tree showed new growth, which was free from mottling on the side where the spray had been applied, but no new growth had developed on the other side of the tree. The mottling on the sprayed side of this tree had disappeared within six weeks of spraying, but at the end of this time the unsprayed side was still markedly chlorotic. Since that time the beneficial effect of spraying half of the tree with sulphate of zinc has spread to the remaining unsprayed portion of the tree.

On the 5th February, 1936, a further spraying with sulphate of zinc was carried out by the second-named author. Two of the trees which had been sprayed on the previous occasion in their entirety were left unsprayed as controls. Two of them were sprayed with 0.5 per cent. solution of sulphate of zinc and the remaining two with a 1 per cent. solution of this material. Certain other trees which had not previously been sprayed were sprayed for the first time. By this time most of the trees in the orchard were showing new growth, but where sulphate of zinc had not been applied the growth on most of the trees was markedly chlorotic. Four of the trees which had not previously been sprayed were sprayed with 0.5 per cent. and four others with 1 per cent. sulphate of zinc solution Two days later it was found that the young growth on all the sprayed trees had

been slightly burned in spots where drops of the spray material had collected, irrespective of whether they had been sprayed only once or on two occasions. This occurred with both the weak and the strong solutions.

On the 13th February the trees which had been sprayed once only with 1 per cent. solution showed a considerable improvement and had resumed 50 per cent. of the normal, healthy colour. The twice-sprayed trees gave the impression that the second spraying had not further improved their general state of health, and may possibly have given them some slight check. On 20th February the trees sprayed once with 1 per cent. sulphate of zinc were free from mottled leaves, and the trees sprayed with ½ per cent. solution showed considerable improvement.

At the time of writing, *i.e.*, 12th of May, 1936, all the sprayed trees are maintaining their improvement and the control trees are still badly mottled, although there has been some slight improvement in their general condition as a result of seasonal changes.

IMPORTANCE OF THE EXPERIMENTAL FINDINGS.

The importance of the above findings is that it has been found in the Maddington-Gosnells area that where citrus trees are planted on sandy or sandy loam soils, the profitable life of the trees seems to cease when they become about 20 years of age. At this age many of the trees will be markedly chlorotic in appearance; they will show a great development of small dead twigs throughout the body of the tree; many of the leaves, in addition to being mottled with light and dark green patches or with yellowish and green patches, are found to be smaller than the leaves of perfectly healthy trees; the production of the trees becomes markedly reduced; the trees become very susceptible to attack by the Anthracnose fungus in so far as the leaves, twigs and fruits are concerned, and, generally speaking, their condition is such as to no longer yield a profitable return to the grower.

As is shown in the accompanying illustration, the loss of green colouring matter in mottled leaves is most pronounced between the veins, the tissues adjoining the veins frequently being more or less normal in so far as their appearance to the eye is concerned.

Some temporary improvement can often be effected by cutting the trees hard back. In some cases, as a result of this treatment, the trees will grow away quite normally for several years, but just when they are due to come into heavy bearing again their temporary improvement starts to fall away. The mottled leaves reappear, dead branches commence to develop with considerable rapidity, the leaves fall readily during the summer months, and the final condition of the trees is no better than their first. Moreover it has been found that if the old trees are pulled out and new ones planted in the same places, the new trees rarely develop into normal mature trees, although they may grow quite well for a few years; the mottled leaf condition sooner or later makes its appearance, a great amount of dead wood develops in the trees, and their fruit production is unsatisfactory. It has been beginning to look, therefore, as though many of our citrus orchards would have to be abandoned at the end of about 25-30 years, except in so far as there may have been paddocks still available which had not yet been planted down with citrus trees.

It is hoped that as a result of the marked improvement which has been brought about by the use of zinc sulphate in the Maddington experiment, many of our citrus orchards will be able to take on a new lease of life.

FURTHER EXPERIMENTS PROJECTED.

As further experiments by the Department of Agriculture in connection with Mottle Leaf of citrus, apple, and plum trees, etc., are being projected, and for various other reasons, it is considered advisable to put on record at this time the experiments which have been so far carried out with zinc sulphate.

Fig. 2.—An orange twig badly affected with the disease known as "mottle leaf," taken on the 12th May, 1936, from one of the control trees referred to in the text.

Photo. by Govt. Printer.

No recommendations are at present being made, however, for the spraying of citrus orchards on a commercial scale with sulphate of zinc, or any other zinc compound such as zinc oxide, until such time as further experiments in connection with the best strengths to use, the best time of applying the sprays, possible

injury to the trees, and so on, have been worked out. Should, however, any growers be desirous of experimenting for themselves, on their own responsibility, the safest procedure would be for them not to spray with sulphate of zinc itself, but to make up what is known as Zinc Bordeaux Mixture at the strength of 5 : 2½ : 50. This spray is made up in exactly the same way as ordinary home-made Bordeaux Mixture, except that the bluestone is replaced by the same weight of sulphate of zinc and only half the normal quantity of quicklime is required. The above formula, being interpreted, means, therefore, that 5 lbs. of commercial sulphate of zinc should be used to every 2½ lbs. of quicklime and 50 gallons of water (8).

Alternatively, Zinc-copper Bordeaux Mixture could be applied at the rate of 2½ : 2½ : 5 : 50; that is to say, 2½ lbs. of bluestone, 2½ lbs. of sulphate of zinc, 5 lbs. of quicklime, and 50 gallons of water. This material is prepared in the same way as ordinary Bordeaux Mixture, half of the bluestone being replaced by an equal weight of sulphate of zinc. This spray has been used by the first-named author on miscellaneous flower-garden and other subjects in experimental work without harmful effects to the plants concerned and with apparent benefit to them.

LITERATURE CITED.

(1) Batchelor, L. D., and Schoonover, W.—"Present State of Citrus Mottle Leaf Studies"—California Citrograph, Vol. 19, Part 5, pp. 112, 132, 1934.
(2) Camp, A. F.—"Zinc Sulphate as a Soil Amendment in Citrus Groves"—Proc. Florida Hort. Soc., 1934, pp. 33–38, 1934. (Abstract in Review of Applied Mycology, Vol. XIV., Part 7, p. 441, July, 1935.)
(3) Chandler, W. H., Hoagland, D.R., and Hibbard, P. L.—"Little Leaf or Rosette of Fruit Trees 111"—Proc. Amer. Soc. Hort. Sci., 1933, Vol. 30, pp. 70–86, 1934. (Abstract in Rev. of Applied Mycology, Vol. XIV., Part 3, p. 176, March, 1935.)
(4) Fawcett, H. S., and Lee, H. Atherton—"Citrus Diseases and Their Control." McGraw-Hill Book Co., Inc., New York, 1st edit., 1926.
(5) Parker, E. R.—"Experiments on Mottle Leaf by Spraying with Zinc Compounds"—Californian Citrograph, Vol. 20, No. 4, pp. 90, 106–107, 1935.
(6) Pittman, H. A.—"Some Important Fungal Diseases of Grape Vines and Fruit Trees in Western Australia and Their Control"—Journ. Dept. Agric. W.A., Vol. XI. (2nd series), No. 3, pp. 488–506, September, 1934.
(7) Pittman, H. A.—"Brown Rot of Citrus—A Serious Disease that Can be Easily Prevented"—Journ. Dept. Agric. W.A., Vol. 9 (2nd series), No. 2, pp. 286–289, June, 1932.
(8) Pittman, H. A.—"Bordeaux Mixture—The World's Most Commonly Used Fungicide" Journ. Dept. Agric. W.A., Vol. XII. (2nd series), No. 4, pp. 410–427, Dec., 1935, *or* Leaflet 314 (1936 edit.).

"THE JOURNAL OF AGRICULTURE"

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SHEPHERD'S LUCERNE.

I. THOMAS,
Superintendent of Wheat Farming.

Information has come to hand that a number of settlers in the Salmon Gums area have received inquiries from farmers in other districts regarding the obtaining of seed of the so-called "Shepherd's Lucerne," a plant very common as a weed in those parts, but which, fortunately, has not spread to the main portion of our wheat-growing areas. Letters inquiring for seed have also been received at the Department of Agriculture.

It is quite apparent, therefore, that those who are inquiring for the seed, presumably for the purpose of introducing it as a pasture plant, are not aware of its definite disadvantages. In the Salmon Gums area, where the absence of native pasture plants is marked, it is proving of value, together with Wimmera Rye Grass, in providing grazing for sheep. Unfortunately, however, because of its characteristics, it is a serious pest in wheat and other cereal crops and causes considerable reduction in yields. Consequently it is very necessary that farmers should be warned against its introduction into other districts.

Shepherd's Lucerne, or, as it is known scientifically, *Lepidium lyssopifolium*, is believed to have been introduced into Western Australia from the Eastern States in fodder used as horse feed before the construction of the Coolgardie-Esperance railway. An early settler—Mr. A. E. Shepherd—appears to have been the first to consider the possibilities of the newly introduced plant, and, from the early connection of his name with it, and the fact that the plant under favourable conditions makes growth in the early summer and remains fairly green throughout the dry months, thus possibly suggesting lucerne to the minds of some, Shepherd's Lucerne came to be the popular name.

Three of the worst weeds in our wheat belt, viz., wild turnip, wild radish and the mustards belong to one family (Cruciferae), most members of which are prolific seed producers, and it is significant that Shepherd's Lucerne, itself a prolific producer of seed, is also of the same family. Of greater significance still is the fact that Hoary Cress (*Lepidium draba*), one of the worst weeds in the Eastern States, is also a close relative of this plant (Shepherd's Lucerne), which some farmers in other parts of the State are apparently seeking to introduce on to their holdings. Shepherd's Lucerne may be annual, completing its growth from a seed and forming new seed all in one season, or it may spread its life cycle over two years and form seed profusely throughout that period. It germinates freely, usually during the winter, but rather later than the cereal crops, and this presents a great difficulty in controlling the weed.

On the fallowed land it requires to be dealt with when quite young. It has a long, tough tap-root, and when allowed to develop it is most difficult to root out with a tyne implement and also difficult to cut it with a disc implement. Cultivations prior to normal seeding time are of little avail, as the seed will not have germinated. During the cold winter months the plant makes little growth, but with the advent of spring it shoots away very rapidly and may grow to a height of up to two feet.

In its early stages Shepherd's Lucerne is a soft-leaved palatable plant, and, according to chemical anaylsis, its feed value is good. Unfortunately, at this stage when growing with the cereal crop it is not available to stock. Later, during the summer months, when the crop has been harvested and stock have access to the Shepherd's Lucerne, it is no longer a soft-leaved plant, but a tall bush, consisting mainly of harsh stems and comparatively few leaves. When in this condition

analysis shows that the plant is far less nutritious, and the older stalks far less palatable than in the early stages of its growth. This point furnishes one of the chief reasons why, with Shepherd's Lucerne, a farmer would be ill advised to attempt to plant and cultivate it under the impression that its bad features may in some way be compensated for by the summer feed that it may provide. It is pointed out that it is only on cultivated land that Shepherd's Lucerne makes its maximum growth. On a paddock the year following a crop considerably less growth is made, and in succeeding years on the pasture paddock Shepherd's Lucerne may be entirely absent, although later, when the land is cultivated and a crop planted with an application of superphosphate, the seeds germinate and the plants make vigorous growth in competition with the crop.

It is obvious, therefore, that a plant having the growth characteristics of Shepherd's Lucerne has not sufficient compensating features to warrant its introduction, as the stock can be provided for in ways less antagonistic to the cropping activities of the farm.

WIMMERA RYE GRASS.

DELAYED SEED GERMINATION.

G. R. W. MEADLY, B.Sc., Assistant Botanist.

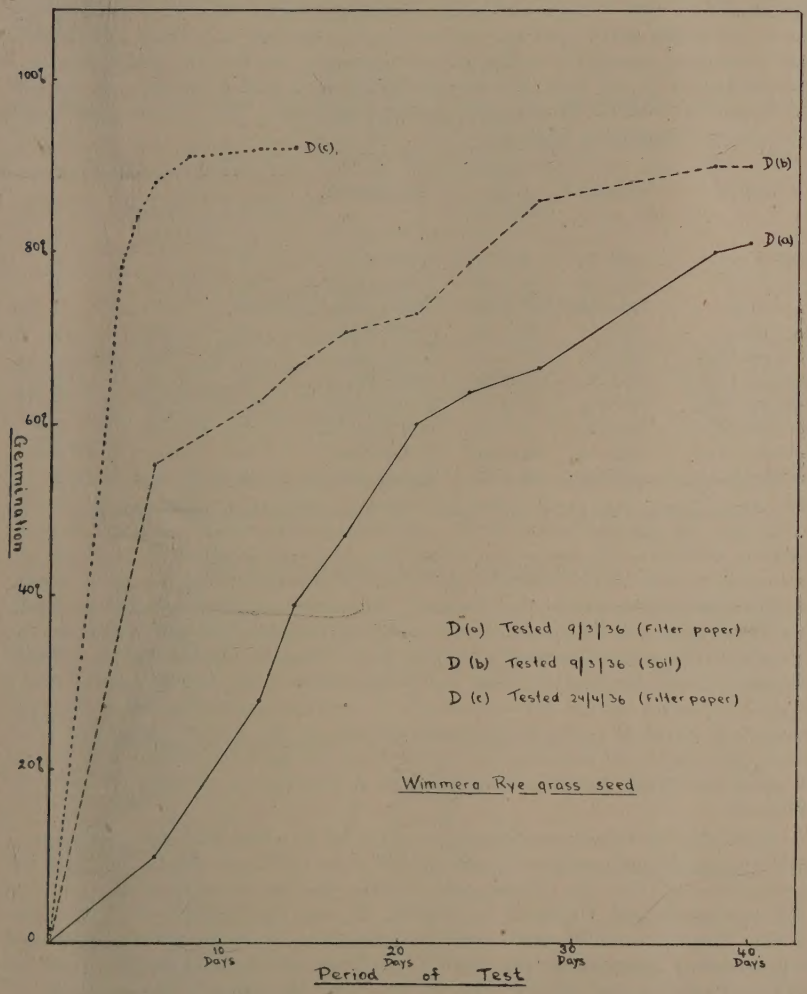
Wimmera Rye Grass (*Lolium rigidum* Gaud var. *subulatum* Fiori) is extensively grown in Australia and is an important constituent of annual pastures in the drier portions of this State. It is normally one of the shortest lived of the rye grass group and is able to reach maturity and set seed during the short growing season experienced in our wheat belt. Although more harsh in stem and leafage than Italian and Perennial Rye grass, it will survive under much drier conditions and "seed down" naturally each season.

A certain amount of Wimmera Rye grass seed is produced locally, but considerable quantities are imported annually from the Eastern States, particularly Victoria. During the last few years, a number of germination tests have been carried out at the Perth seed-testing station on both local and imported lines of seed and the resultant figures have shown a large variation. A good average germination for Wimmera Rye grass seed is 85 per cent., yet, although the seed appeared quite satisfactory, the average germination after fourteen days (the standard period) of seed imported from Victoria in 1935 and tested in the first three months of that year was less than 30 per cent. Germination was still taking place at the end of fourteen days, and in most cases 50 per cent. germination was secured after about 20 days.

The rate was particularly slow, however, as a vigorous line of Wimmera Rye grass seed will germinate to the extent of 60-70 per cent. in three days and complete its germination of 85 per cent. or more in fourteen days. Locally produced new-season seed tested during the same three months gave 78 per cent. germination in fourteen days. Later tests carried out in May of the same season gave average germinations of 84 per cent. for both local and Victorian new season seed.

The large increase in the case of the Victorian seed suggested that an after-harvesting ripening period was necessary before a satisfactory germination could be expected. The difference was not so marked in the case of local seed, possibly due to harvesting under drier conditions or earlier, thus allowing a longer after-

harvesting maturing period at the time of testing. In order to investigate these assumptions a series of tests were carried out. Firstly, a line of new-season seed from Victoria, tested on 27th March, 1935, was retested on 10th March, 1936. The earlier test gave a germination of 29 per cent. in 12 days, increasing to 38 per cent. after 14 days, while a year later the figures were 86 per cent. in 6 days,



Graph showing rate of germination.

and 90 per cent. in 14 days. Besides showing a remarkable increase in germination the rate was also increased, the seedlings being much more vigorous. All the preceding tests were carried out on moist filter paper under glass bell jars at temperatures alternating between 20 degrees C. for 18 hours and 25 degress C. for 6 hours.

Secondly, a line of new season Victorian grown seed was tested on both sand and filter paper on 9th March, 1936, and 24th April, 1936. The results of these series of tests may be traced from the accompanying graph. As in the previous season, the rate of germination of the March test was very slow, but was hastened by placing the seeds on moist sterilised sand. The tests were continued for 40 days in order to secure, as far as possible, maximum germination. The April test gave a high percentage germination in a short time as shown by line D (c) of the graph, and the seedlings were vigorous in growth. Trials with local seed gave a parallel to the previous season's results. On 3rd February a germination of 75 per cent. was secured in 14 days, and a further test on 13th March gave a result of 90 per cent. in the same time. The following table provides some comparative figures:—

Sample.	Season.	Test Commenced.	Substratum.	Germination.		
				6 days.	12 days.	14 days.
				%	%	%
Local A (a) ...	1934–35	6–3–35	Filter Paper ...	64	...	78
Local A (b) ...	1934–35	11–4–35	Filter Paper ...	80	...	84
Local B (a) ...	1935–36	3–2–36	Filter Paper ...	50	71	75
Local B (b) ...	1935–36	13–3–36	Filter Paper ...	83	88	90
Victorian C (a) ...	1934–35	27–3–35	Filter Paper ...	5	29	38
Victorian C (b) ...	1934–35	10–3–36	Filter Paper ...	88	90	90
Victorian D (a)	1935–36	9–3–36	Filter Paper ...	10	28	39*
Victorian D (b) ...	1935–36	9–3–36	Sterilised soil...	55	63	67†
Victorian D (c) ...	1935–36	24–4–36	Filter Paper ...	88	92	92
Victorian D (d) ...	1935–36	24–4–36	Sterilised soil ...	88	90	90

* Test continued gave 81 % in 40 days. † Test continued gave 90 % in 40 days.

DISCUSSION AND CONCLUSIONS.

Delayed germination in grass seeds is not uncommon, and as cited by N. R. Foy (1) samples of wheat, oats and barley are frequently found which do not give complete germination within the standard testing period of 10 days. Almost invariably these samples are from newly harvested lines, and give satisfactory germination after having been stored for a month or more. Probably the most pronounced example is the delayed germination in the case of Paspalum (*Paspalum dilatatum*) and the seeds of Prairie grass (*Bromus unioloides*) also require an after-harvesting ripening period before a satisfactory germination may be obtained.

Reverting to Wimmera Rye Grass, however, if a low and slow germination results at the beginning of the year there is always the possibility that this will not improve, as there are inferior lines of this seed on the market, as is the case with most seeds. E. O. Hyde (2) reports the low germination of certain lines of New Zealand certified perennial Rye Grass seed, it being observed that seed of poor quality is produced when humid conditions predominate during the period between flowering and the ripening of the seed. He suggests the possibility of a fungus present on the seeds causing their death, and this aspect is under observation. In any case the relative humidity at the time of seed formation has a direct bearing on the rate and amount of germination. It appears that under the dry conditions experienced in the harvesting areas of this State the germination is not appreciably affected. Seed development under moister atmospheric conditions, however, requires a certain after-harvesting maturing period, and in extreme cases a poor germination will result which cannot be improved.

In cases of delayed germination the seed purchaser does not suffer a disadvantage as when sowing time (April at the earliest) is reached the seed has fully matured.

It was noticed while conducting tests that the Wimmera Rye grass seed with low vigour early in the season germinated quicker on sand than on filter paper. Later when germinating in a normal manner no difference was evident between the two substrata.

LITERATURE CITED.

(1) N. R. Foy—Delayed Germination in Cereals. New Zealand Journal of Agriculture: Vol. 44, No. 2, p. 129, Feb. 20th, 1932.
(2) E. O. Hyde—Germinating Capacity of Perennial Rye Grass Seed. New Zealand Journal of Agriculture: Vol. 44, No. 5, pp. 316-319, May 20th, 1932.

AGRICULTURAL PROBLEMS

Agriculturists, pastoralists and primary producers generally, who may be having difficulties of any kind in connection with their production activities, are invited to communicate with the Agricultural Adviser of their district of the Department of Agriculture, when information and advice will be supplied free of charge.

Where identification of plant or stock diseases or insect pests is required, full details of symptoms should be forwarded and also samples of the diseased plant, animal tissue or insect where practicable. Plant tissue intended for examination by the Plant Pathologist should be wrapped in paper and not forwarded in airtight containers, and plant specimens for the Botanist should be pressed between newspaper and dried before despatch. With regard to animal tissue for microscopic examination, this should be forwarded in a solution of 10 per cent. formalin, or if of considerable bulk in a sealed kerosene tin containing a few ounces of formalin as a preservative. Living insects should be sent in suitable containers and dead specimens in methylated spirits.

The addresses and names of Advisers are as follows:—

Albany	A. C. Vaughan.
Bridgetown	A. Flintoff.
Bunbury	M. Cullity.
Denmark	V. L. Cardon.
Geraldton	G. L. Throssell (Government Buildings).
Gosnells	R. C. Owen.
Harvey	D. L. Breen (Fruit); C. Giles (Dairying).
Katanning	A. S. Wild
Kalamunda-Roleystone	W. H. Read, c/o. Department of Agriculture, Perth.
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Metropolitan, Gingin, Chittering ...	S. E. Bennett, c/o. Department of Agriculture, Perth.
Metropolitan to Spearwood ...	R. L. Cailes, c/o. Department of Agriculture, Perth.
Mundaring	V. Cahill.
Narrogin	H. R. Powell.
Northam	F. L. Shier.
Northcliffe	H. S. Rogers.
Vasse	J. M. Nelson.

M. T. PADBURY TROPHY COMPETITION.

I. THOMAS,
Superintendent of Wheat Farming.

A further year's results are available for the above competition, which has now been conducted for a period of six years, viz., 1930-1935 inclusive.

This competition was inaugurated in 1930 as the result of a generous donation made by Mr. M. T. Padbury, a pioneer farmer of the Moora district, and will cover a period of ten years, i.e., the final year will be in 1939.

The trophy is a handsome shield, and each year a replica is made and presented to the winner for that year. This minor trophy was won for the past season by Hon. T. Moore, M.L.C., of Indarra, who obtained the excellent average of 4 bushels 6 lbs. per inch of rainfall over an area of 275 acres.

The conditions under which this competition is conducted are as follow:—

1. The competition will commence with the 1930-31 harvest and continue for a period of 10 years. At the end of that period the trophy will be awarded to the competitor who has taken part in the competition for at least five years, and who obtains the greatest mean average acre yield per inch of rainfall during the conventional growing period. The mean average yield will be computed from the results of the five seasons in which the competitor produced the highest acre-yield per inch of rainfall during the growing period. In the event of a tie the competition will continue between the leading competitors until an advantage is gained by one of them.

2. The conventional growing period for any year will be that decided upon and announced by the Royal Agricultural Society. For the first year, and until further notice, it has been decided that it will be from May 1st to October 31st, inclusive.

3. Until the end of the competition the trophy will be in the custody of the Royal Agricultural Society, and will be displayed at any agricultural exhibition held by that society.

4. Each year the competitor who obtains the best average acre yield per inch of rainfall during the conventional growing period will be awarded a replica of the trophy. His name will also be inscribed upon a small shield affixed to the trophy.

5. The rainfall upon which the award will be made will be determined by the Commonwealth Meteorologist from the district records, and his decision in this matter will be final.

6. The competition will be limited to those farmers who harvest at least 200 acres of wheat for grain. Where a competitor is financially interested in the crops grown on one or more farms, he will be required to supply details regarding the production and marketing of the crops on same, and, though usually the award will be made upon the results from the farm nominated by the competitor, the Royal Agricultural Society may require that the crops on these farms be included in the competing area.

7. The average yield will be ascertained from the total area—including self-sown crops—harvested for grain, and determined from the actual amount of wheat sold, as shown by the delivery dockets, plus the amount retained for seed, for home use or for any other purpose.

8. The method of judging will be as follows:—At a convenient time the area harvested for grain will be measured and the quantity of wheat on hand ascertained. On or before January 31st the farmer will be required to furnish the judge with a sworn declaration as to the quantity of wheat sold from the competing holding or holdings, and the amount retained for seed and other purposes; the statement regarding the amount sold to be supported by agent's dockets. The judge, after satisfying himself as to the correctness of this statement, will compute the average yield per acre per inch of rainfall during the growing period from the information received.

9. The judge will be appointed by the Director of Agriculture, and his decision will be final.

10. Nominations for this competition will be received by the Royal Agricultural Society up to the 31st October each year.

The results for 1935 are as follow:—

M. T. PADBURY TROPHY COMPETITION.

Results for 1935-36.

Competitor.	Address.	Rainfall during growing period.	Area Harvested.	Yield. Gross.	Yield. Average per acre.	Yield. Average per 1in growing period rain.
		points.	acres.	bus. lbs.	bus. lbs.	bus. lbs
Hon. T. Moore ...	Indarra ...	591	275	6,651 20	24 11	4 6
N. A. Scadding... ...	Kulin	1,119	440	12,141 13	27 21	2 27
R. H. White	Gnowangerup...	1,052	239	6,090 55	25 30	2 25
J. R. Bremner & Son...	Corrigin ...	915	907	18,455 40	20 8	2 12
R. T. Best	Koorda ...	743	499	5,138 39	10 18	1 23

FIELD EXPERIMENTS WITH WHEAT AND OATS.

AGRICULTURAL RESEARCH STATION, WONGAN HILLS.

I. Thomas, Superintendent of Wheat Farming,
and
A. R. Venton, Farm Manager.

Although the past season was, on the whole, a satisfactory one, there were several periods during which considerable anxiety was felt. Although nearly ¾in. of rain fell during the first few days of April it was not followed by another good fall until nearly the end of May. The early April rains brought about a partial germination of weeds which were destroyed by cultivation during the ensuing dry spell.

The main seeding operations were delayed until 2nd May in the hope of rain, but after that date planting proceeded as quickly as possible. As was only to be expected, weed growth was in evidence in some of the dry sown areas.

The May and June rains were below the average; July was about equal to it, while the registrations for August and September were better than the average. During the last three months, however, cold dry winds considerably retarded crop growth. With the warmer weather towards the end of September the crops grew rapidly. The October rainfall was of little value, only 23 points being recorded, spread over seven days, but fortunately conditions were comparatively cool.

As a result of the dry finish the crops did not yield so well as appearances at the end of September indicated and the grain was not so plump as usual.

The rainfall recorded at the farm during 1935, together with the monthly averages for the 10 years 1926-35, is given in the following table.

Year.	Growing Period.												Total for Year.
	Jan.	Feb.	Mar.	Apl.	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Nov.	Dec.	
1935	82	134	8	92	96	127	286	292	147	23	971	...	1	1,288
1926-35 ...	36	42	89	94	162	242	290	210	93	88	1,090	27	34	1,409

The land on which the experiments were conducted was tussocky sand-plain country and in places was rather gravelly. It was ploughed with a sundercut disc cultivating plough during the winter of 1934 and was skimmed ploughed in September with the same implement.

Most of the area was cultivated with a springtyne implement in May and again just before seeding.

The results of the various field experiments are tabulated below.

RATE OF SEEDING EXPERIMENT—WHEAT.

To determine the most economical rate for planting a midseason free-stooling variety.

Planted on 4th June. Superphosphate—120lbs. per acre. Variety—Nabawa. Germinated on 14th June.

Rate of Seed.	Computed Yields per Acre.					Average Yields per acre, 1935.	Percentage Yields, 1935.	Average Yields per acre, 1925-35.	Percentage Yields, 1925-35.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	%	bus. lbs.	%
60lbs. per acre ...	22 16	22 16	22 32	22 40	23 36	22 40	99	16 53	102
45lbs. per acre ...	22 32	22 0	22 32	23 20	24 0	22 53	100	16 29	100
90lbs. per acre ...	22 48	22 32	22 32	24 0	24 8	23 12	101	16 57	103

To determine the most economical rate for planting an early sparse-stooling variety.

Planted on 4th June. Superphosphate—120lbs. per acre. Variety—S.H.J. Germinated on 14th June.

Rate of Seed.	Computed Yields per Acre.					Average Yields per acre, 1935.	Percentage Yields, 1935.	Average Yields per acre, 1925-35.	Percentage Yields, 1925-35.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	%	bus. lbs.	%
60lbs. per acre ...	20 56	20 0	19 36	19 28	19 20	19 52	103	14 7	103
45lbs. per acre ...	19 4	19 52	19 36	18 48	18 56	19 15	100	13 42	100
90lbs. per acre ...	20 8	20 24	19 52	20 0	20 8	20 6	104	14 26	105

The results are similar to those of previous years and indicate that there is no advantage to be gained by increasing the rate of seeding above 45 lbs. per acre.

TIME OF PLANTING EXPERIMENT.

To determine the most suitable month to plant a midseason maturing variety.

Superphosphate—120lbs. per acre. Variety—Nabawa. Seed—45lbs. per acre.

Date Planted.	Computed Yields per Acre.					Average Yields per acre, 1935.	Percentage Yields, 1935.	Average Yields per acre, 1928-35.*	Percentage Yields, 1928-35.*
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	%	bus. lbs.	%
April 15th	20 32	19 36	21 12	19 28	20 0	20 9	72	16 42	99
May 16th	27 44	29 44	27 28	28 8	26 48	27 58	100	16 52	100
June 17th	19 20	22 0	20 16	21 4	20 32	20 38	74	11 38	69

* Excluding 1934, when experiment was not carried out.

To determine the most suitable month to plant an early maturing variety.

Superphosphate—120lbs. per acre. Variety—Gluyas Early. Seed—45lbs. per acre.

Date Planted.	Computed Yields per Acre. Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.	Average Yields per acre, 1935.	Percentage Yields, 1935.	Average Yields per acre, 1928-35.	Percentage Yields, 1928-35.
	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	%	bus. lbs.	%
June 18th	15 12	18 8	16 32	17 28	17 4	16 53	67	11 54	75
May 16th	21 28	26 0	24 48	26 40	26 16	25 2	100	15 46	100
July 16th	12 24	13 44	11 44	15 12	14 48	13 34	54	8 4	51

The results for last season are in agreement with the average results for the past eight years and demonstrate very forcibly the inadvisability of prolonging the seeding period to the middle of June.

RATE OF APPLICATION OF SUPERPHOSPHATE EXPERIMENT.

To determine the most profitable amount of superphosphate to apply to the wheat crop.

RATE OF APPLICATION OF SUPERPHOSPHATE EXPERIMENT.

No. 1.

Planted on 1st June. Germinated on 11th June. Variety—Nabawa. Seed 45lbs. per acre.

Rate of Super.	Computed Yields per Acre. Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.	Average Yields per acre, 1935.	Percentage Yields, 1935.	Average Yields per acre, 1929-35.	Percentage Yields, 1929-5.
	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	%	bus. lbs.	%
225lbs. per acre ...	33 52	34 16	33 52	34 48	31 28	33 39	101	20 6	10
150lbs. per acre ...	32 48	33 44	34 16	33 52	32 24	33 25	100	19 40	100
300lbs. per acre ...	33 44	33 36	33 20	34 8	34 16	33 49	101	20 8	102

RATE OF APPLICATION OF SUPERPHOSPHATE EXPERIMENT.

No. 2.

Planted on 31st May. Germinated on 10th June. Variety—Nabawa. Seed—45lbs. per acre.

Rate of Super.	Computed Yields per Acre. Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.	Average Yields per acre, 1935.	Percentage Yields, 1935.	Average Yields per acre, 1929-35.	Percentage Yields 1929-35.
	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	%	bus. lbs.	%
Nil	...	...	...	...	...	...	...	3 8	17
150lbs. per acre ...	22 48	21 28	22 32	28 24	29 52	25 1	100	18 28	100
75lbs. per acre ...	17 20	17 4	15 28	17 4	20 40	17 31	70	14 31	79

This year's results confirm those of previous years and show that to this class of country rates of superphosphate in excess of 75 lbs. per acre can be profitably applied. At present prices an application of at least 120 lbs. per acre is warranted.

No grain was harvested from the plots receiving no superphosphate. Only on two occasions have returns been obtained from the "no super" plots and these were due solely to the residual effects of an application of superphosphate in a previous season. In these two seasons there was no land available for cropping to which superphosphate had not previously been applied.

POTASH NITROGEN EXPERIMENT.

To determine the effect upon the wheat crop of (a) a nitrogenous fertiliser; (b) a nitrogenous plus a potassic fertiliser.

Planted on 31st May. Germinated on 10th June. Variety—Nabawa. Seed—45lbs. per acre.

Treatment.	Computed Yields per Acre. Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.	Average Yields per acre, 1935.	Percentage Yields, 1935.	Average Yields per acre, 1932–35.	Percentage Yields, 1932–35.
	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	%	bus. lbs.	%
Super, 112lbs; Sulphate of Ammonia, 112lbs. per acre	37 28	39 4	39 28	39 52	39 20	39 2	123	24 48	121
Super, 112lbs. per acre	29 28	30 56	32 32	32 40	33 4	31 44	100	20 36	100
Super, 112lbs.; Sulphate of Ammonia, 112lbs.; Sulphate of Potash, 56lbs. per acre	39 12	39 20	39 52	38 56	37 44	39 1	123	25 18	123

The yields for last year and for previous years show that on country of this type, even in fallowed ground, there is a definite increase in yield following the application of 1 cwt. of sulphate of ammonia. Last year the increase was a payable one, but on the average over a number of years, the extra cost of the fertiliser has not been offset by the increased yields obtained.

The addition of a potassic fertiliser in addition to the sulphate of ammonia has not given any response so far.

SEASONAL PLANTING EXPERIMENT.

To determine (a) the most suitable month to plant the late, midseason and early varieties of wheat; and (b) the most prolific of these types.

APRIL PLANTING.

Planted on 15th April. Germinated on 4th June. Superphosphate—125lbs. per acre. Seed—45lbs. per acre.

Variety.	Computed Yields per Acre. Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.	Average Yields per acre, 1935.	Percentage Yields, 1935.	Percentage Yields, 1928–35.
	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	%	%
Yandilla King ...	21 12	21 12	21 12	19 20	18 40	20 19	103	102
Nabawa	20 32	20 24	20 16	18 48	18 24	19 41	100	100
Sutton	24 24	26 8	24 48	25 28	23 28	24 51	126	*112
Bencubbin	22 32	26 24	25 12	26 24	24 48	25 4	122	†118
Nabawa	20 16	21 44	20 16	19 20	21 4	20 32	100	100
Gluyas Early ...	22 24	22 32	21 28	21 36	21 44	21 57	107	94
Totadgin	20 22	21 20	20 32	20 0	19 44	20 22	95	‡93
Nabawa	21 44	22 0	21 20	21 12	19 44	21 22	100	100
	* 1931–35.		† 1930–35.			‡ 1932–35.		

MAY PLANTING.

Planted on 15th May. Germinated on 4th June. Superphosphate—125lbs. per acre. Seed—45lbs. per acre.

Variety.	Computed Yields per Acre. Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.	Average Yields per acre, 1935.	Percentage Yields, 1935.	Percentage Yields, 1928–35.
	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	%	%
Yandilla King ...	21 28	22 8	22 8	20 48	24 32	22 13	95	91
Nabawa	24 8	22 24	22 8	21 52	26 40	23 26	100	100
Sutton	25 52	23 4	25 4	24 16	28 0	25 15	108	*97
Bencubbin	27 28	24 16	25 44	25 4	30 0	26 30	116	‡111
Nabawa	24 32	21 28	23 12	22 24	22 8	22 45	100	100
Carrabin	27 20	26 16	25 28	22 16	24 40	25 12	111	100
S.H.J.	21 28	20 8	16 48	16 24	20 56	19 9	92	90
Nabawa	21 36	18 0	18 56	19 44	26 0	20 49	100	100
Merredin	19 12	18 24	18 8	20 48	24 8	20 8	97	†92
Gluyas Early ...	21 12	19 28	20 48	21 20	24 0	21 22	95	†94
Nabawa	22 40	20 8	22 40	22 32	24 48	22 34	100	100
Totadgin	21 36	18 16	17 28	20 0	22 48	20 2	89	§88
Geeralying	22 32	19 20	18 56	18 56	22 40	20 29	90	†87
Nabawa	24 24	20 40	21 44	22 16	25 4	22 50	100	100
Noongaar	22 48	21 20	20 32	21 52	25 44	22 27	98	73
	* 1931–35.		† 1929–35.		‡ 1930–35.		§ 1932–35.	

JUNE PLANTING.

Planted on 17th June. Germinated on 28th June. Superphosphate—125lbs. per acre. Seed—45lbs. per acre.

Variety.	Computed Yields per Acre. Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.	Average Yields per acre, 1935.	Percentage Yields, 1935.	Percentage Yields, 1928–35.
	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	%	%
Geeralying	20 16	19 28	24 24	25 44	25 12	23 1	99	†90
Nabawa	20 16	20 16	24 8	24 24	26 56	23 12	100	100
Bencubbin	16 40	18 40	23 28	26 0	26 48	22 19	96	*105
Carrabin	18 24	16 56	21 52	24 24	27 20	21 47	106	96
Nabawa	15 12	16 48	20 56	25 4	25 4	20 37	100	100
S.H.J.	13 28	16 8	19 44	22 40	24 32	19 18	94	90
Gluyas Early ...	15 12	18 0	20 16	25 20	25 4	20 46	95	91
Nabawa	16 32	19 28	20 56	26 40	25 52	21 54	100	100
Totadgin	14 8	17 52	18 0	22 48	24 32	19 28	89	‡84
Merredin	15 20	20 0	18 48	24 40	25 20	20 50	102	†94
Nabawa	14 48	19 20	19 20	23 36	24 56	20 24	100	100
Noongaar	17 28	24 40	23 20	28 16	28 16	24 24	120	93

* 1930–35. † 1929–35. ‡ 1932–35.

In the April sown plots the late maturing variety "Sutton" and the midseason variety "Bencubbin" have shown to advantage not only in the results for this year, but also in the average results over a number of years. The same two varieties also yielded well in the May sown sections though on the average results for four years "Sutton" has not equalled the control variety "Nabawa."

As a result of good yields in the past two years the average yield of the premium variety "Carrabin" in this section is now equal to that of the control.

In the June planted section for this year "Carrabin" has again yielded better than the control. "Noongaar" was outstanding in this section, yielding 20 per cent. better than the control variety "Nabawa." This was probably accounted for by the dry finish to the season, as usually at this farm, "Noongaar" does not show to advantage.

RATE OF SEEDING EXPERIMENT (OATS).

To determine the most economical rate for planting (a) a late maturing oat variety, and (b) an early maturing variety.

Planted on 3rd June. Germinated on 13th June. Variety—Algerian. Superphosphate—120lbs. per acre.

Rate of Seed per Acre.	Computed Yields per Acre. Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.	Average Yields per acre, 1935.	Percentage Yields, 1935.	Average Yields per acre, 1926–35.	Percentage Yields, 1926–35.
	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	%	bus. lbs.	%
45lbs.	17 8	17 0	16 8	17 0	16 24	16 32	108	16 2	107
30lbs.	15 24	15 8	14 32	15 32	16 16	15 22	100	15 2	100
60lbs.	16 24	17 16	17 24	17 24	18 8	17 19	112	16 21	110

Planted on 4th June. Germinated on 14th June. Variety—Burt's Early. Superphosphate—120lbs. per acre.

Rate of Seed per Acre.	Computed Yields per Acre. Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.	Average Yields per acre, 1935.	Percentage Yields, 1935.	Average Yields per acre, 1926–35.	Percentage Yields, 1926–35.
	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	%	bus. lbs.	%
45lbs.	21 0	24 8	25 8	24 24	23 8	23 26	108	16 21	102
30lbs.	19 0	22 24	23 8	22 16	22 0	21 34	100	16 5	100
60lbs.	23 24	25 8	25 0	22 16	22 16	23 29	109	16 29	104

For both the late maturing variety "Algerian" and the early maturing variety "Burt's Early," the results both for this year and for a period of 9 years, indicate that no significant increase in yield is obtained by planting at a rate greater than 45 lbs. per acre.

OAT VARIETY TRIAL.

To determine the most prolific varieties of oats under the conditions obtaining at this farm.

Planted on 6th June. Germinated on 16th June. Superphosphate—120lbs. per acre. Seed—45lbs. per acre.

Variety.	Computed Yields per Acre.										Average Yields per acre. 1935.		Percentage Yields. 1935.	Percentage Yields. 7 years.
	Sec. 1		Sec. 2.		Sec. 3.		Sec. 4.		Sec. 5.					
	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	%	%
Laggan	22	0	21	8	22	8	26	0	24	8	23	5	130	.
Burt's Early	16	32	16	0	17	8	18	24	20	16	17	32	100	100
Kanota	10	16	11	16	13	24	16	24	21	32	14	30	83	*91
Guyra	18	32	13	16	19	24	22	32	21	16	19	8	100	.
Burt's Early	18	32	14	8	18	32	22	0	22	0	19	6	100	100
Mulga	14	16	13	0	16	0	22	24	21	24	17	21	91	95
WI	26	0	26	8	27	32	30	16	31	16	28	14	151	.
Burt's Early	17	0	17	8	19	8	19	24	20	24	18	29	100	100
Algerian	11	0	10	0	13	8	19	16	20	16	14	32	79	110
Guyra	11	24	11	8	12	32	16	0	20	32	14	19	70	99
Burt's Early	20	0	19	32	20	8	23	0	20	32	20	30	100	100

* 3 years.

A late start and a dry finish, this resulted in the late maturing variety "Algerian" making a poor showing as compared with results in previous years. Conditions suited the variety "Laggan" and also the new crossbred "WI" which yielded exceptionally well in its first trial under field conditions.

DISEASES OF BEES.

H. WILLOUGHBY-LANCE,
Apiculturist.

Few people realise that bees, like other creatures, are subject to many forms of disease. It is necessary, therefore, to remind bee-keepers that although the normal condition is good health, they should always be on the lookout for anything abnormal in the condition of the brood, or of adult bees. Keepers of bees soon become accustomed to the signs of good health in the brood and adult bees. Any departure from this should be watched and if the abnormal condition continues, it should be immediately reported to the Department of Agriculture. Failure to report disease lays the bee-keeper open to a fine of £20.

Some diseases are very infectious and liable to spread very rapidly, others are easily dealt with, and some under suitable conditions cure themselves.

Naturally bees thrive best, and are able to resist disease easiest, when their food and living conditions are such as to keep them healthy and vigorous. Some of these conditions are:—

(1) Warm, comfortable and dry hives;
(2) Cleanliness in and around the hives;
(3) Strong colonies headed by vigorous queens;
(4) Plenty of reserve stores of honey and pollen.

The question of hives is too lengthy to be dealt with here. Leaflet No. 308, obtainable from the Department, deals with hives. I would, however, warn bee-keepers against using second-hand hives without ascertaining that they are not second-hand because the bees have died of disease. But under any circumstances

they should be thoroughly disinfected. If purchasing from an unknown person or district, he should communicate with the Agricultural Department, as it might save him much trouble and loss.

Dealing with cleanliness, all hives should be cleaned once a year. A number of hives should be prepared during the winter, and when the bee-keeper makes his spring examination the colonies should be transferred to these. The old hives should then be thoroughly cleansed and scrubbed with a disinfectant. Some use a solution of Calvert's No. 5 Carbolic, but the disinfectant largely used by bee-keepers in Great Britain is Izal: the strength being one part Izal to 300 of water. Izal is a non-poisonous antiseptic, not objected to by the bees.

Floor boards should not be fixed to the body of the hives if it can be avoided, as they are so much more difficult to clean properly. Bee-keepers who frequently move their hives from one site to another usually fix the floors to the brood chambers, and keep a number of spare brood chambers ready for changing the brood frames into if necessary. If the floor board is loose it is an easy matter to cleanse at any time in addition to the annual cleaning, by lifting the body on one side and scraping away any refuse.

In cases where the apiarist supplies water for his bees, it is advisable to add a little Izal to this, especially if he suspects that there is any disease in the neighbourhood. The Izal will act as an antiseptic, the solution being 1 in 300. If feeding has to be resorted to, 1 oz. of Izal to 80 lbs. of sugar and 6 gallons of water is recommended as a good antiseptic.

The bee-keeper should make himself familiar with the early symptoms of the various diseases, so that he may take prompt measures to deal with same, and to communicate at once with the Agricultural Department.

There is one cause of infection over which the apiarist unfortunately has no control, and that is from empty honey containers thrown out on the rubbish heap, which are cleaned up by the bees and disease thereby often carried into the hives. In several cases this appears to be the only reasonable cause for the breaking out of disease in certain districts. There is only one thing the bee-keeper can do, that is to keep his eyes open for both old containers and the appearance of disease. Another cause is the robbing of honey from a neighbouring colony that has died of disease.

If, therefore, it is thought that disease exists in the neighbourhood, the Department of Agriculture should be communicated with, and steps will be taken to prevent its spread if it is found to exist.

One of the most important things next to cleanliness is to keep all colonies strong in bees; any weak ones in the autumn and spring should be united. Those getting weak through an old or failing queen should be requeened if there is sufficient honey and pollen coming in.

To keep bees healthy and vigorous, there should always be a good reserve of honey and pollen on the hive. Never rob the hive bare of honey, even in the midst of a good flow; you never know when the flow may shut off suddenly. A good practice is to have half depth supers on every hive as food chambers; this should be full of capped combs for the winter, so that when brood rearing commences in the spring, and large quantities of honey and pollen are used for feeding the brood, there will be no danger of a shortage. When the hive becomes strong, the food chamber should be raised and an extra super placed between it and the brood chamber. Always keep the food chamber; and as the extra honey supers are removed, bring it down again on to the brood chambers for the winter.

It should be remembered that the temperature of all parts of the hive where brood is being reared must be from 90 to 97 degrees Fahr. The stronger the colony the easier it is for the bees to keep up this temperature. The weaker the

colony, or the colder the outside temperature the more food (honey or sugar syrup) has to be eaten and exercise taken to produce the necessary heat. The smaller the cluster of bees, the warmer must the centre of the cluster be to keep up the temperature of the outside of the cluster. If the temperature falls below 46 Fahr., the bees on the outside stiffen and die unless they take exercise and consume food.

Flying bees use five or six times as much energy when flying as when walking: if she is weakened by shortage of food or disease, she may be able to walk, but not fly. Hence crawling bees in front of the hive may be caused by either of the above. If it is starvation, it is the bee-keeper's privilege to remedy this. If it is disease, it is his duty to report the matter so that the disease may, if possible, be diagnosed and remedial action taken.

Bees are naturally clean insects and void their excrements when flying. If, therefore, yellow or brown spots, which are the excreta of the bees, are seen in the hive, or on the alighting board, disease may be suspected.

Disease may be brought into a hive in several ways:—

1. By healthy bees robbing honey from a diseased hive. By young bees from a diseased hive while out on a "play flight" drifting into other hives. By foraging bees and water carriers carrying home disease germs dropped by diseased bees. By swarms from diseased colonies. By the use of second-hand hives which contain the germs of disease.
2. By feeding with honey from a diseased hive (diseased only as far as the bees are concerned, as no germ that attacks human beings can live in honey).

It will be seen, therefore, that bee-keepers who wish to make a success of their calling, or hobby, and do not wish to be a menace to their fellow bee-keepers, cannot afford to be careless or indifferent to the dangers of disease.

If a colony becomes weak from an unknown cause, or shows abnormal symptoms, investigate it at once, or get some competent bee-keeper to do so for you.

As soon as any colony is found to be diseased, the entrance should be restricted varying from ½ inch to 3 inches according to the strength of the colony, and the danger of infection from the disease. The object of this is to prevent robbers entering the hive and carrying the disease to other hives. The entrance should be kept restricted until the hive has been successfully treated or destroyed.

Moths.

A distinction must be made between moth-infested hives and diseased hives. Moths should be classed amongst the pests, not diseases.

There are two wax moths, the lesser (*Achroia grisella*) and the greater (*Galleria Mellonella*). It is not the moth itself that is the pest, but the grubs prior to turning into the chrysalis: these grubs feed on the wax and pollen, preferring the brood combs in which are the skins of the bee chrysalis, and spin webs all over the comb.

One great danger of empty moth-infested hives is that the colony may have been so weakened by disease that it becomes an easy prey to the moth, and the bee-keeper, finding an empty hive, does not know that the first trouble was disease, the germs of which are still in the hive.

When, therefore, a hive is found to have been destroyed by wax moth, all combs and refuse should be cleaned out and burnt; and the frames boiled for at least twenty minutes in water to which caustic soda has been added, the boxes and floor being scorched with a blow lamp. This will destroy both moth eggs and disease germs.

Brood Diseases.

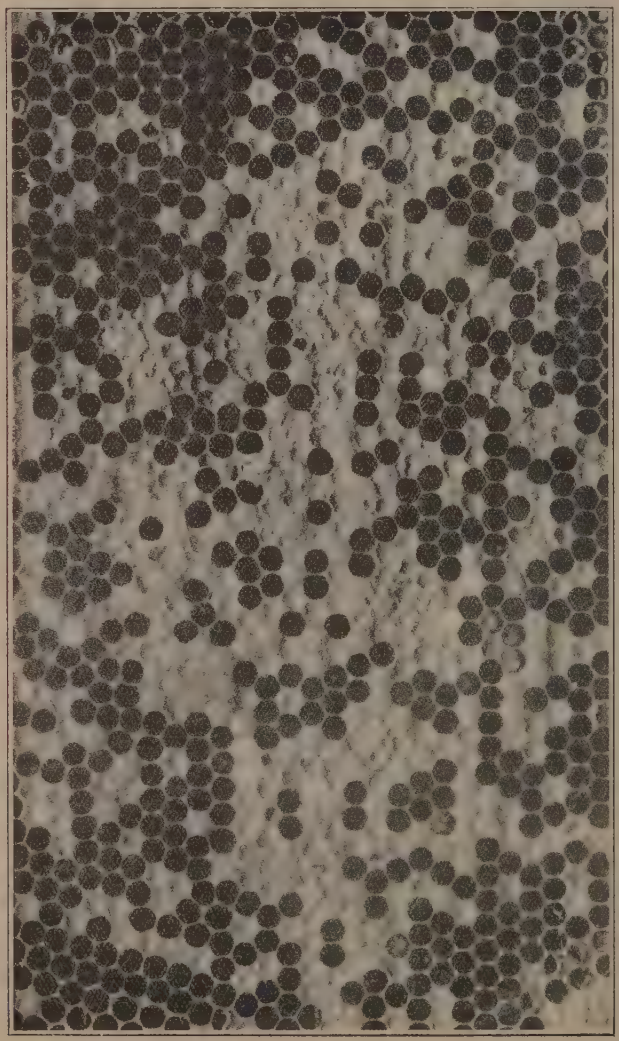
The following table taken from "The Diseases of Bees," by Miss A. D. Betts, will assist bee-keepers to diagnose any abnormal symptoms in the brood.

KEY TO THE DISEASES OF BROOD.

Disease	Age of Dead Brood.	Colour.	Odour.	Scale.	Other Signs.
American Foul Brood	Sealed brood, and few pupae. Some unsealed brood also, in bad cases	Yellow, then brown (coffee and milk) to dark brown	Like bad glue, not very powerful	Roughish curled up at head end. Sticks tightly to cell-wall	Moist remains more or less ropy. Cocoon present.
European Foul Brood	Unsealed brood. Sealed also in advanced cases. Bees may remove all unsealed dead grubs	Whitish, then yellow, finally often very dark brown	Usually an appalling stench, especialy if sealed brood dead; but may be slight or sourish only	Smooth silky-looking, with pale cross lines. Easily removed from cell	Moist, remains pasty. Remains in sealed cells may be somewhat ropy. No cocoon in sealed cells.
Para Foul Brood ...	Sealed and unsealed brood ...	Similar to last two, but remains often have a reddish tinge	Slight to very bad (last usually from sealed cells)	... ...	Contents of sealed cells may be ropy. Cappings often deeply sunken but not perforated.
Sac Brood	Sealed brood (larvae) ...	White to yellow, later brown. Head often darker	None until an advanced stage, when there may be an unpleasant odour	Roughish curled up at head end. Easily removed from cell	Watery granular contents in a tough skin. Cappings may be perforated. Bees often remove portion of the dead grubs.
Chalk Brood	Sealed brood (larvae) ...	Yellowish, then white and fluffy, finally white, grey or black	None	Hard smooth mummies ...	May be white all over or blackish in spots.
Stone Brood	Sealed and unsealed brood ...	As last, but finally brown or greenish mould	None	Hard mummies covered with mould	Not yet noted in Britain or Australia.
Addled Brood ...	Advanced pupae (nearly ready to emerge)	Pale brown or greyish ...	None	... ...	Small shrunken fully-formed bees found dead.
Chilled Brood ...	All ages, including eggs. ...	White, grey or black, seldom brownish	None, or slightly sour ...	... ...	All the brood in a comb is usually dead.

AMERICAN FOUL BROOD.

A.F.B. is the worst disease that Australian bee-keepers have to fight. The germ *Bacillus larvae,* which is the causative agent, is usually carried in honey, or on combs, but is also carried on the frames and the hive itself, and may lie dor-



American Foul Brood (Bacillus larvae) in an advanced stage. Note the patchiness of the brood and the sunken cappings. The few white spots and raised cappings are healthy brood.

Fig. 1.

mant for years until conditions are suitable for its growth. It does not appear that any country where commercial bee-keeping is practised is free from it. In some parts of America and New Zealand it has caused the loss of thousands of pounds' worth of stock. In spite of much better inspection in New Zealand than

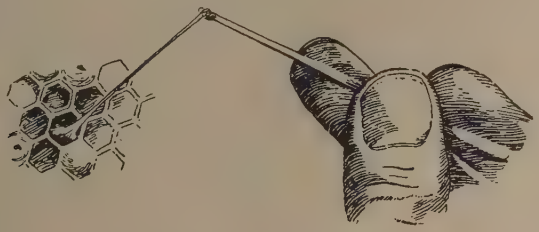
in Australia, it has got such a hold that, under the Apiaries Act, no one is allowed to move any bees whatever, whether they are in a diseased district or not, without notice to the Agricultural Department.

Signs.

The brood usually dies during the four days immediately after the sealing of the cell, and before the formation of the pupae. Unsealed brood is generally healthy.

It may be detected by the smell coming from the entrance to the hive, or upon lifting the cover, the odour being like that of an old glue pot being warmed up on the stove.

Upon examination of the combs some of the capping will be found to have a much darker brown colour than the healthy ones, and to be sunken, or to have small pin holes in the centre. Sometimes the bees uncap the diseased brood and endeavour to remove the dead matter. This, however, they cannot do, as it sticks tightly to the cell walls either as a sticky brown mass, or as dried-up scale. (See Fig. 1.)



One test for American Foul Brood.
Note how the diseased larvae draws out.
(*Photo. from U.S.A. Dept. of Agric., Bulletin No.* 442.)
Fig. 2.

Suspicious looking cells should be tested in the following manner:—If a splinter of wood is thrust into the cell and withdrawn, a sticky mass of brown or coffee and milk colour will adhere to it, and upon withdrawing same will string out to half an inch or more, and then break up and fly back like elastic. (See Fig. 2.)

After a while these rotten masses dry up into a dark brown tongue-like scale, adhering firmly to the bottom edge of the cell. These contain the spores of future generations, being patchy and scattered all over the comb.

This is the most dangerous condition, and is not easily detected and may lie dormant for several years, until suitable conditions arise for germination. Spores kept in a laboratory for over three years have been cultivated and produced the active form of the disease. The best way to detect these spores is to hold the comb at an angle so that the light falls on the lower cell walls, when the tongue-like mass will be seen at the edge.

The disease may be contracted at any time during the year. Honey may be brought in from diseased colonies that have weakened or died out. This honey may be capped over and the disease not start until it is used to make the larval food by the "nurse bees." Bee larvae is practically the only culture medium in which the spores of *Bacillus larvae* will germinate and grow. Outbreaks usually

occur in the spring when brood rearing takes place, and cells of honey are uncapped for use when there is a shortage of food, also of fresh nectar coming in, as this is the time when old honey is uncapped for use, and when robbing takes place.

Treatment.

For many years the shaking treatment was in use in America for hives slightly infected, but this did not seem to stay the ravages of the disease, owing to the careless manipulations of many bee-keepers. The method now usually adopted is to smother the bees, dig a large hole, light a fire therein, and place the complete hives, with bees and all, on the fire. After complete destruction the whole remains, which often contain diseased honey that has run out of the combs, is covered with earth.

This is the treatment recommended to bee-keepers who are sure that it is a case of American Foul Brood, and the Department of Agriculture must be notified. If the bee-keeper is in doubt as to what disease his bees are suffering from, a sample of the comb should be sent to the Department of Agriculture. The disease may be a curable one, or the Department may allow the bee-keeper to use the shaking treatment and save the bees.

When a colony is destroyed by fire, it is best to smother the bees at night when no bees are flying, and burn at once; so that there will be no flying bees about to feed on any honey that may run from the combs.

When the bee-keeper has handled a diseased colony his hands may become infected, and anything he handles may become infected, therefore, after completing the work of destruction, he must disinfect his hands, tools, etc., that may have become infected: the ground where the hives stood should be dug over, the surface of the ground being turned underneath.

The only sure disinfectant for American Foul Brood is a solution of 20 parts formalin and 80 of water. Izal is good and also soda, but not so reliable as formalin.

EUROPEAN FOUL BROOD.

This occurs more in unsealed brood than with sealed, although it sometimes occurs in the latter.

It is not so serious as American Foul Brood, as the bees can and will remove the dried up scales from the cell walls, which they cannot do in the case of American.

Signs.

The first sign is usually the presence of gaps, or of cells with eggs or young grubs, in what would otherwise be a solid slab of capped brood.

Grubs four or five days old usually die, but younger ones or sealed brood may also succumb, especially in bad cases. The grub loses its plump appearance, turns yellow, then brown, and frequently a dark brown similar to A.F.B. Sometimes the sealed brood dies, and the cappings may be sunken or perforated. The remains, however, are not ropy as with A.F.B. and will not spring back like elastic.

If the bees remove all dead unsealed brood, leaving only dead sealed brood, this may have a bad smell something like A.F.B., probably caused by *Bacillus alvei*, which is frequently present in association with *B. pluton* in cases of European Foul Brood.

Cause of Infection.

For many years the germ *Bacillus pluton* has been considered as the cause of European Foul Brood, while another germ, *Bacillus alvei*, was frequently found in association with *B. pluton;* as *B. alvei* was also found in healthy colonies, *B. pluton* was put down as being the cause of the disease.

Recent investigations into the cause of European Foul Brood by H. L. A. Tarr at Rothamstead Experimental Station, England, however, throws doubt upon what had previously been accepted as fact. After a long description of his experiments, in which he finds *Streptococcus apis* and *Bacillus alvei* in association in all cases of European Foul Brood, he summarises as follows:—

"As far as can be ascertained from the findings described here there seems no reason for supposing that 'European foul brood' is caused by the hypothetical *Bacillus pluton* of White. It does seem probable that the disease is merely a mixed infection of the brood of weak stocks of bees. Certainly this is the view at present held by Borchert who has recently found certain apparently new bacilli in what was probably a disease of the 'European foul brood' type. The present writer has discovered an apparently fresh species in two cases of this type of disease. Burnside, in the United States, has found what appears to be a type of 'European foul brood' (Parafoulbrood), in which he finds that an apparently new bacillus somewhat similar to *B. alvei* (*Bacillus para-alvei*) is an important invader. All this may be regarded as increasing evidence that so-called 'European foul brood' is by no means a well-defined single disease, and that it is more probably a mixed bacterial infection of the brood of weak stocks."

It will therefore be seen that the actual cause of European Foul Brood is still very uncertain, but whatever the cause the following treatment has been found the most effectual:—

Treatment.

E.F.B. does not usually attack strong colonies with plenty of stores; if such become infected they usually throw it off. It is most important, therefore, to keep all stocks strong and clean. If the disease is discovered, remove and burn all combs showing the slightest sign of infection, as in A.F.B., being careful not to allow any honey from the combs to escape. Unite any weak diseased colonies, crowding the bees on to the combs, and provide with combs of sealed honey from a healthy colony, or feed with sugar syrup. It is also advisable to re-queen the colony with a young pure-bred Italian or Carniolan queen. The hive itself should be disinfected by scorching, by means of a blow lamp, to a dark brown, or boiling for 20 minutes in a strong soda solution.

If the disease is in an advanced stage, it is safest to destroy the whole outfit with fire, as in American Foul Brood. It is possible, however, for the bees to clean it up, which they cannot do with American Foul Brood.

PARA FOUL BROOD.

This is a disease recently diagnosed in America, and so far has not been proved to exist in Australia. It is a disease of both unsealed and sealed brood, and resembles both American and European Foul Brood, both in appearance and in smell. The most distinguishing sign at present known is the tendency of the remains to be reddish or reddish-brown.

Cause.

Bacillus para-alvei, which much resembles *Bacillus alvei*, but is a distinct species.

Treatment.

Until more is known of the disease, the safest method is to treat as for American Foul Brood, and destroy.

SAC BROOD (sometimes called Pickled Brood).

Signs.

A disease of sealed brood, before the larvae reaches the pupae stage, the dead brood usually being scattered about the comb. The cappings may be perforated or sunken, or may have been uncapped by the bees. The colour of the dead larvae varies from a pale yellow to a dark brown, the head often being the darkest. The larvae is, however, never a rotten mass as in foulbrood. The skin remains tough and is full of a watery or pasty mass. It can be removed from the cell whole, and when the skin is punctured the watery mass escapes.

In the last stages of the disease the dead larvae has lost all its moisture by evaporation, and has dried up to a dry mummy-like scale, which can easily be removed intact from the cell.

Cause.

A filtrable virus, too small to be seen under an ordinary microscope.

The disease may be spread by crushing a sick grub in syrup and feeding, but the dried-up scale has not been found to cause infection.

The disease is not frequent, and the causes of infection are not known: it is usually mild in form and does not spread.

Treatment.

Colonies often throw it off without help. It is well, however, to take away and destroy the diseased combs, providing the bees with clean combs and stores from a healthy hive.

SOUR BROOD.

So far we have no knowledge of the existence of this disease in Australia, and there appears to be very little information concerning it. *Streptococcus apis* is considered to be the cause.

CHALK BROOD.

We have not come across any cases of this disease in Western Australia, but a description of it may be made here in case it appears.

Signs.

The brood, usually drone grubs recently sealed, turns yellowish white, and becomes covered with a fluffy white mould; they are also full of the mould within. They dry up into hard lumps, lose their fluffiness, and look like lumps of chalk or white pollen; they may turn grey or black. When quite dry they sometimes rattle in the cells when shaken.

The disease may occur at any time while breeding is taking place, only attacking a colony here and there, and is not "epidemic."

Cause.

A mould or fungus *Pericystis apis*, and related to the pollen mould *Pericystis alvei*.

Treatment.

Cut out the diseased combs, also scrape the floor and burn combs and scrapings. Disinfect the floor with Izal. In bad cases transfer the bees to a clean hive and combs, burning the old combs and disinfecting the hives.

STONE BROOD.

This is another disease that does not appear prevalent in Western Australia, and is not known in Great Britain.

Signs.

Like Chalk Brood at first, but later the brood develops a rough surface greenish or brown mouldy growth, like old combs containing dead brood left in a damp place.

As the disease progresses, the adult bees are attacked, die, and become hard "mummies," as also does the mouldy brood.

Cause.

One of the moulds belonging to the genus *Aspergillus*. Some of those that occur on jam and old combs are harmless; but the mould causing this disease not only destroys the colony, but has been known to attack the higher animals, including man; thriving best in high temperatures, entering the lungs and other respiratory passages, and causing disease. The danger of infection is not considered great for healthy persons, nevertheless care should be taken not to inhale the spores (coloured dust on the surface of the growth).

Treatment.

Smother the bees immediately, and burn the complete hive with all contents in a hole in the ground: the honey is not safe for human consumption.

It is advisable whilst doing the work to protect the mouth and nose with a wet handkerchief, to prevent any risk of inhaling spores.

This is the only disease known to attack both brood and adult bees.

CHILLED BROOD AND OVER-HEATED BROOD.

Signs.

All, or nearly all the brood in a comb is dead: if some are alive, it will be where the bees have kept it warm. The dead brood will not be scattered as in infectious diseases. It turns either grey or black, not brown.

Cause.

Exposure of the brood by the bee-keeper for too long a period on a cold day, or standing the frames out exposed to a very hot sun. It may also result when the bees have reared more brood than they can cover, and there is a sudden change from hot to cold weather.

Treatment.

The dead brood is past treatment, and no more brood will die if there are sufficient bees to keep it warm.

The combs of dead larvae may be removed and kept in a dry place until they have dried up; they may then be returned to a strong colony for the bees to clean up.

Prevention.

See that there are sufficient bees in the hive to cover and keep the brood warm in case of a cold spell. Do not spread the brood in the early spring to encourage brood rearing, as this causes the bees to neglect to cover the brood unless they are very strong. Do not expose combs of brood to cold winds or very hot sun.

POISONING.

Occasionally brood is destroyed by bringing in poison with the nectar, pollen, or water, the poison coming from the spraying of trees while in blossom, washing of sheep, or other human causes.

It is also thought that certain pollens are poisonous, but no definite investigation work has been done in this direction.

Poisoning may affect either the brood or adult bees, or both.

ADULT BEE DISEASES.

ACARINE DISEASE (Isle of Wight Disease).

This is the most serious disease of those affecting adult bees. It is present in the British Isles, Germany, Switzerland, and parts of France and Austria, but so far has not invaded America or Australia.

Signs.

Signs of the disease are sick bees crawling or running along the ground away from the hive, some that are too weak to run far dying near the hive. The sick bees may be of all ages, and have their bowels somewhat extended. The wings are usually dislocated, the hind wing sticking out sideways, while the fore wing is in its usual resting position. As these symptoms are somewhat similar to those of other diseases, the only sure method of diagnosis is by dissection and microscopical examination.

Cause.

A mite, *Acarapis woodi*, sometimes called *Tarsonemus woodi*, which breeds in the tracheae (breathing tubes) of the bee: it is very small and invisible to the naked eye. The mites pierce the walls of the trachea with their sucking mouth parts and live on the bee's juices. The mites pass from one bee to another and rapidly infect the young bees, which are the most susceptible.

Treatment.

For many years no remedy was found for disease, and thousands of colonies fell victims to the disease. After many experiments a remedy was found by Mr. Frow. This is known as the Frow treatment. Space will not, however, be taken up in giving details, as it is hoped that it will never be needed in Australia.

NOSEMA DISEASE.

This disease varies from a mild chronic form to virulent malady. It is frequently present in the mild form with no visible sign that anything is wrong, and is usually at its worst in the spring when the bees resume active work.

The disease is very prevalent in parts of Europe and is not unknown in Australia, but has never assumed epidemic form.

Signs.

Dead bees in front of the hive, others, young or old, slowly crawling about or climbing up grass stems, etc., and usually making trembling movements with their wings, these not being dislocated, and the bees not running actively away from the hive as in Acarine Disease. Bees will also be found lying on their backs on the alighting board or the ground with their legs in the air. The abdomens may be swollen and if the bees are pinched the bowel contents may squirt out for several inches.

The only sure method of diagnosis is microscopical examination.

Cause.

A microbe or very small animal parasite *Nosema apis,* which infects the lining of the bee's stomach. It is a member of the Protozo family, which is the cause of a variety of diseases of man and animals.

The spores of Nosema pass out of an infected bee with the contents of the bowel and is the general cause of infection. If a spore is swallowed by a healthy bee, it passes down to the stomach and there shoots out a long thread 100 times as long as a spore which acts as an anchor. Soon afterwards a little speck of living jelly creeps out of the spore, divides into numerous portions, each of which enters a stomach cell and divides into a great many more little parasites; finally each of these become a spore, some germinate in the same bee, others pass out and infect other bees in due course.

It is evident that a serious infusion of Nosema must affect the stomach action of the bee and the digestion of her food, thus making her weak from semi-starvation. As the queen may also be diseased and become weak the stamina of her progeny will also be affected.

Treatment.

Keep all the stocks strong so that the "disposition" of the colonies may be unfavourable to the disease, and any sudden weakening noticed.

If possible see that the drinking place is kept clean and protected so that no dead bees or excreta can fall into it.

If the disease is discovered while the colony is still strong it may be treated by shaking the bees in front of a clean hive some distance from the old stand, so that the young bees can easily run into the new hive, while the old bees will return to the old stand. These old bees should then be smothered and burnt, together with the old combs. The queen should also be destroyed.

The young bees should be crowded on to as many combs as they can cover and when they have settled down given a young pure-bred queen.

In many cases, however, the best way to stop infection is to burn the lot in a deep hole and cover up well.

The ground where the diseased hive has stood should be turned over after the dead bees have been gathered up and burnt.

Everything is liable to be infectious, including the bee-keeper's hands and feet if he has trodden on any bees. Everything should be disinfected, including the drinking place. Bees should be encouraged to drink near the apiary; this may be done by putting a little salt, honey or sugar in the water in a suitable vessel with hessian or sacking to prevent the bees being drowned.

AMOEBA DISEASE.

This disease is mainly a spring disease, and is probably one of the many causes of what is sometimes known as the "disappearing trouble" or "spring dwindling"; the colony getting weak by the disappearance, from not apparent cause, of flying bees.

An Amoeba—that is a parasite which has no definite shape, but is simply a minute speck of jelly, is the cause of this disease. If conditions are favourable, the parasite grows a thick skin and turns into a cyst. These cysts are swallowed

by the bees and produce more parasites, which enter the Malpighian tubes and multiply there. In three or four weeks these again produce cysts, which pass out with the excreta, and the infection is spread.

Treatment.

At present no cure is known for the disease, and it is best to destroy the colony and thoroughly cleanse the hive and ground.

PARALYSIS.

This is a disease that occurs in the spring and in many ways its appearance is similar to that of Nosema.

Signs.

Many dead and dying bees in front of the hive; at first mainly old bees, and later young ones. They give off an unpleasant odour both before and after death. Many of the dead bees are hairless, dark and shiny. Some may be seen crawling and are not usually shiny, being in the early stages of the disease. They are often weak on their hind legs.

The bowel contents are pale and watery and some may become smeared over the bee. If the bowel contents are normal, or it is nearly empty, the honey sack may be full of watery fluid. The excreta may shoot out when the bee is pinched, as with Nosema. Many bees die with their tongues stretched out. Bees may also be seen on the alighting board dragging sick bees out and biting off their hair.

Cause Unknown.

It is thought by some to be a bacterial infection of the digestive organs, and only infectious by contact with sick bees. In some parts of Europe it usually prevails when the bees are getting honeydew from certain species of fir trees. An observer in Cheshire, England, found all the symptoms of dysentery to coincide with the time of rhododendron blossom, particularly of a certain species.

Again, others put the cause of this disease as being due to unsuitable food gathered in the autumn, and used by the bees during the winter whilst they are less active.

Treatment.

The disease usually passes away of itself, but in the meantime the colony may have become very weak. If the queen, however, is very prolific she may be able to keep up the strength of the colony in spite of the heavy mortality; this prolificacy may, however, have a tendency to weaken the stamina of the young bees. Although the disease usually dies out as the summer advances, it frequently appears again the next spring.

The most effective method of treatment has usually been found to re-queen, with a good pure-bred queen from a colony that has never suffered with the disease.

MAY SICKNESS.

This is a disease of young nurse bees.

Signs.

The young bees, mostly under 13 days old, rush out of the hive, trying to fly, in a state of great agitation; often it occurs after a cold spell, and passes off after the weather improves.

Cause.

A serious form of constipation due to the overloading of the bowel with pollen, which the nurse bees eat to make the brood food; sometimes attributed to the pollen of certain plants or to the eating of pollen from mouldy combs.

Treatment.

The only treatment advised in serious cases is feeding with thin warm syrup: the trouble does not usually last long.

DYSENTERY.

This frequently accompanies other diseases, but it may occur as a separate disease.

Signs.

Yellow or brown spots on the alighting board, inside the hives, and on the combs.

Causes.

Overloading of the bowel through being confined to the hive; the consumption of unsuitable food; a damp or draughty hive; starvation, lack of honey causing the bees to eat pollen.

Treatment.

This will depend on the cause which the bee-keeper should try to ascertain, and then remove or remedy it.

POISONING.

Bees sometimes die in large numbers, due to poisoning from outside sources. Mostly young bees are affected, frequently showing signs of dysentery. The bowels are full of fluid, not solid pollen as in May sickness; the dead bees often being doubled up.

Causes.

The spraying or dusting of plants with insecticides containing arsenic or other poison; dust or fumes from chemical works; drinking water in which sheep have been washed; poisoning by the nectar or pollen of certain plants.

Treatment.

No treatment is possible. Poisoning from spraying, however, should not occur, as trees should not be sprayed whilst in full blossom. This should be done before or after the opening of the blossom. The spraying whilst in blossom causes the death of many beneficial insects, including bees, which are necessary for pollination purposes. Most orchardists recognise that bees are among their best friends. Sprayed blossoms cause the death not only of the foraging bees, but of the nurse bees and brood in the hive, as poisoned pollen may be taken home. Lime, sulphur, nicotine, and kerosene are not harmful, as the bees are repelled by these.

Many of the plants of Australia, the foliage of which is poisonous to stock, are good honey producers, and the honey quite harmless.

A few cases of poisoning by honey have been recorded, more particularly in America, not only amongst bees, but amongst humans. We are not, however, aware of any authentic cases in Australia, although it is quite possible that some of the unexplained deaths amongst bees may be due to poisoned honey or pollen.

Grape juice brought home by the bees from punctured and damaged grapes often causes honey to ferment in the combs, making it unsuitable for food and causing deaths amongst the bees.

It may here be mentioned that it has been proved beyond doubt that bees themselves cannot puncture grapes; they only suck the juice from those already damaged.

BEE LOUSE (*Braula coeca*).

This is a parasite that attaches itself to the head of the bee, frequently the queen, and feeds on honey from the mouth parts of the bee: to secure this it irritates or tickles the bee, causing it to exude the food from its mouth. This is not a serious menace, but if much infestation takes place it may weaken the stamina of the bees. The louse is small but can be detected by the naked eye.

Treatment.

A few pieces of naphtha or camphor placed on the floor at the back of the hive causes the louse to drop off, and is not injurious to the bees.

STARVATION.

This of course is not a disease, but bee-keepers have been known to mistake it for such. On opening up a hive a large number of dead bees are seen on the floor; many bees are seen with their heads in cells, only their tails being visible. The few remaining bees are seen crawling about quite listlessly. If further examination is made, it will be seen that there is no honey in the combs.

It is probable that by the time the discovery is made there will be too few bees to take the trouble to save. If, however, it is thought that there are sufficient bees to build up, they should be crowded on to one or two frames and a frame of honey given, bruising some of the cappings. These combs should be placed in a small nucleus hive, or if this is not available, the combs in use should be closed off from the other part of the hive by a division board. Make sure there is a queen present, if not a laying one should be introduced.

If a comb of honey is not available, they should be fed with a warm syrup made from 2 pints of honey or sugar to one of water.

ADDLED EGGS OR BROOD.

A few cases occur where the queen's eggs never hatch. In this case the bee-keeper will always find eggs in the cells, but never any brood. Occasionally cases occur in which the eggs hatch but the brood dies in the pupal stage; the combs being full of sealed cells none of which hatch, and if opened will be found to contain shrunken pupae or small shrunken fully formed bees.

The cause is some abnormality in the reproductive organs of the queen. The only remedy is to re-queen.

DESTROYING A COLONY.

The bees of a colony are destroyed by poisonous or suffocating vapour of some kind. It is necessary, therefore, that all cracks or openings in a hive that is to be destroyed should be stopped up. The hive should be prepared during the day, so that the destroying substance may be inserted after the bees have ceased flying with as little disturbance as possible.

Cyanagas is quick and handy, a couple of teaspoonfuls placed on a piece of cardboard and pushed in at the entrance, which should be immediately closed up tightly, quickly destroys the bees. Care must be taken, however, not to inhale the poisonous fumes from the powder whilst doing it.

Sulphuring.—This is not so easy, as the burning sulphur requires a space above it so that it does not burn the frames or melt the combs. An empty super should therefore be placed under the brood chamber to contain the tray of burning sulphur. All hive joints where the fumes might escape should be carefully stopped and the entrance closed.

Carbon Bi-sulphide.—If this is used, a saucer containing about two dessert-spoonfuls of the liquid should be placed on top of the frames, not underneath, as the fumes fall instead of rising.

Petrol.—Place a quilt or rag all over the top of the brood chamber and pour a cupful of petrol on it. No light should be allowed near the hive, as a mixture of petrol and air in certain proportions is highly explosive; therefore do not use a lighted smoker.

HONEY.

In some cases of disease honey may be highly infectious to bees, but quite harmless to human beings. Honey taken from diseased hives must not be sold to the public, as they are often careless and throw out empty tins, thus spreading the disease to a new district. It may with safety be consumed by the bee-keeper, family and friends, as he will doubtless see that empty tins are not thrown out to re-infect his own and neighbour's bees.

SENDING SAMPLES.

In cases of suspected disease which the bee-keeper cannot diagnose from the foregoing descriptions, a piece of the suspected comb not less than three or four inches, or a couple of dozen adult bees recently dead, or sick bees by preference as dead bees soon decay and become full of bacteria, should be sent to the Government Apiculturist.

Use a box which cannot be smashed in transit, wrap the comb or bees in clean paper, using sufficient paper so that the comb does not shake about in the box; then wrap the box in brown paper and tie securely. Use a tie-on label marked "Sample for examination." Do not send honey with the comb. Send a separate letter fully describing the symptoms, and say what you suspect.

The Department will examine the sample free of cost, and advise you what action to take, and if necessary the Apiculturist will visit you.

THE BEES ACT.

Bee-keepers should remember four important things as required by the "Bees Act":—

First—Each apiary of one or more hives, or any place where bee-keeping material is kept, must be registered with the Department of Agriculture within fourteen days of its establishment, whether permanent or temporary.

Second—The bee-keeper must notify the department in writing immediately he finds any diseased hives, whether he is treating the disease himself or not.

Third.—All bees must be kept in movable frame hives so that the combs can be removed without cutting or breaking.

Fourth—Instructions given by an officer of the department must be carefully carried out.

It should also be remembered that the Apicultural Branch has been established to assist to the best of its ability every bee-keeper, whether large or small, and any advice or instructions given will be for your benefit. You are therefore asked to assist the Branch that is anxious to assist you in the control and elimination of disease.

Acknowledgment.

In compiling this article we wish to acknowledge our indebtedness to the book on "The Diseases of Bees" by Miss A. D. Betts, for the latest description and information on some of the diseases with which we are not familiar; also to the "Bee World" and other journals for the latest scientific information.

DUCKS.

G. D. SHAW,
Poultry Adviser, Department of Agriculture.

PART 2.

Indian Runner and Khaki Campbell.

INDIAN RUNNER.

This beautiful duck is much in favour as an egg producer. Its carriage and habits make it a worthy bird for the fancier, and also for the farmer who requires eggs for his income. It is not a flesh producer, but there is no doubt that the flesh of the Indian Runner is a delicacy.

The breed is of Indian origin, introduced into England many years ago, but it is only during recent years that it has found favour with poultry farmers.

It is generally agreed that all the domestic varieties of ducks are descendants from the wild Mallard duck, but the Runner differs greatly in structure and carriage from that breed.

Varieties:

Two varieties are generally acknowledged—the fawn and the white. The white variety is of very recent origin.

Standard:

The main points to look for in both varieties are—

Flat skull—long straight bill—with eye placed high;
Neck, long and tapering gradually;
Sloping well-shaped shoulders;
Very upright carriage with active nervous disposition.

The Runner duck is an exceptionally heavy layer, but they have a very bad habit of moulting at the least expected times. Being of a very nervous disposition they must be handled with care, as anything unusual to their ordinary habits will send them into a moult.

The advent of motor cars along roads near the duck pens has been a serious cause of loss to the poultry farmer. Aeroplanes passing overhead have also been credited with being a cause of moulting.

It is always advisable to pen the Indian Runner duck away in that portion of the farm which is the quietest, that place which is least liable to inspection by visitors and other activities which may upset their nervous nature.

KHAKI CAMPBELL.

This wonderful duck is noted for its productivity. Mrs. Campbell, of Gloucester, England, is its originator. The Khaki Campbell duck is a product of Runner—Rouen and wild Mallard. The flesh is slightly dark in colour, but is delicate in flavour. Of only recent origin (it was produced about 1901) this breed is now recognised as foremost in egg production. The breed has been consistently improved, and is now more fixed in type.

Mating, breeding, and feeding are similar to that required for all egg-producing ducks. The standards required are—Drake: head, back and wing bar bronze brown, rest of body khaki in colour; legs, dark orange; bill, dark green. Duck: khaki all over—back and wings are laced an even shade of khaki; bill, greenish black; legs are as near body colour as possible.

A white bib is a serious defect, and should not be allowed in the breeding pen. The body is deep, wide and compact, showing good depth. A well-developed abdomen and well-rounded breast and stern. Eyes full, bold, and bright, high in skull and prominent. The carriage is slightly upright with head carried high. This breed is very active and they are good foragers. The weights for both sexes are similar (approximately 4½ lbs.).

Sexes:

The sexes are not easily distinguished until the birds reach about eight weeks, when the tone of the voices will be the best guide. A hard "quack" will denote the duck, and a soft voice is that belonging to the drake.

At maturity the tail, together with plumage, carriage, and the masculine features, will mark the male from the female bird. The tail feathers of the drake will curl upwards, and are easily distinguished by small hook-like feathers curling over towards the back.

Housing:

Runners and Khaki Campbells need very little in the way of shelter, but they must be protected from winds; rains they relish, but a wind is a definite source of danger to egg-production. Fences only two feet high will be quite suitable as an enclosure, and by having a shady yard with a breakwind little other shelter is required, except over the nests. They must of course have a dry position for their sleeping quarters. Nothing is more fatal to all ducks than damp sleeping quarters.

Dry quarters, good breakwind, good shade, and a two-feet fence is all that is required in order to house a flock of Runners or Khaki Campbells.

Breeding:

These ducks are prolific layers, and it is commonly agreed that all laying strains of poultry, etc., are not at all reliable as mothers. It is therefore necessary to incubate the eggs either by hens, muscovy ducks, or by the artificial means of an incubator.

Mating is best accomplished by penning one drake to four or five ducks. It is advisable to pen four ducks during the early period, and as the season advances other pens may be broken up and the ducks distributed in order to increase the numbers of ducks in each pen to five or six, according to the vitality of the drake.

Fertility is not of the best early in the season; frights, changes of weather, and changes of quarters will also naturally affect the fertility.

Cases have been known where the fertility has been 100 per cent. one week and nil the next. This is one of the main problems the duck farmer has to combat. No reason can be given.

Collect the eggs early, and clean at once. It is best to wash all filth from the eggs before setting. Water will not hurt them.

The time for mating and incubating is after the chicken season, *i.e.*, the end of September and October. The best results are obtained when operating during these months. One can even extend into November.

Incubating:

The chick season having finished one can continue to use the machines which have been in use on previous chick hatches, but adjustments must be made in order to obtain the correct temperature. As it is not anticipated that activities will be sufficiently extensive to make the use of mammoth machines necessary, this aspect will not be studied. The eggs take 28 days to hatch. The small machines, up to 480 eggs, have proved quite satisfactory.

The most common machine is the hot air machine—the air being heated by a kerosene lamp. In these machines the air is introduced into the egg chamber, and the eggs are thus surrounded by air at the required temperature. The more evenly the egg chamber is heated the better the results, and to this end action must be taken before eggs are set to ascertain that all parts of the egg tray are heated to an even temperature. To do this it is necessary first to test the thermometers with a control. This is done by placing the control in a basin of water and adding hot water until 103 deg. is attained. Immerse the other thermometers and compare the readings. When all thermometers are adjusted insert into incubator at all corners of tray and check readings. (All bulbs should be of even height from bottom of tray (approximately $1\frac{3}{4}$ inches). A variation of $\frac{1}{2}$ deg. is of no moment, but 1 deg. or more should condemn the machine.

The next procedure is to regulate the temperature of the machine to run consistently at 102 deg. before admitting the tray of eggs. The thermostat is located inside the chamber. It should not need interference.

A small screwed rod (a) projects upwards and through the top of the machine connecting with the regulator. Before starting to adjust the regulator see that the weight (d) is in such a position that when no strain is applied by the thermostat and rod (a) the damper is lightly closed. By operating the lock nut (b) the damper (c) is made to lift or lower as desired until the heat controlled allows of the hatching chamber being constantly at the desired temperature.

When running, the damper should be "floating" about one-eighth of an inch above the heater. This allows of flexibility of control.

There is a marked correlation between the size of the lamp flame and the floating position of the damper, and one should aim at the fine adjustment which, while not jeopardising heat, should conserve the fuel.

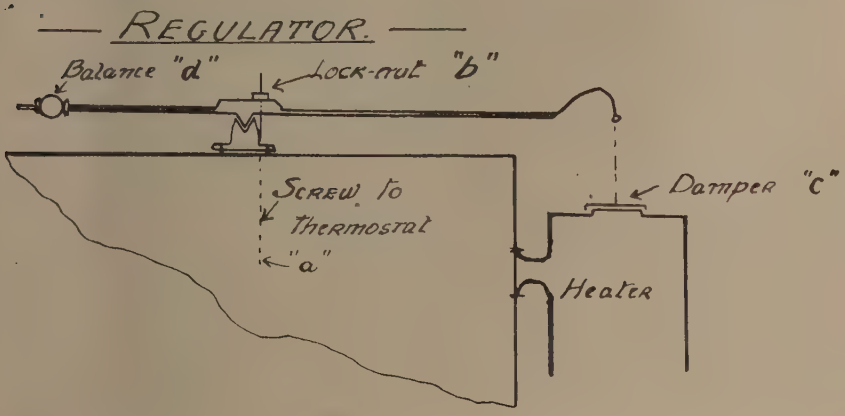
Incubator Room:

It is of little use having perfect machines if they are operated in imperfect rooms. An incubator room need not be of elaborate design, but it certainly must embody plenty of fresh pure air—even temperature day and night (not unduly influenced by climatic conditions), and space enough to operate the machines with comfort.

The egg needs large quantities of fresh air; any restriction will cause a weakened germ with a resultant weakly duckling. The more eggs contained in the machine the greater the supply of oxygen required, so see that the room will allow of plenty of ventilation—good air in and bad air out.

Any sudden rise or fall in outside temperatures should not have too marked effect on the inside temperature of the room. Drastic variations are due to badly insulated rooms. When building, see that the room is lined, and make due allowance for ventilation. Do not restrict space where incubators are concerned. Ease in adjustment, filling and cleaning are just as important as fresh air. All these factors assist in the efficiency of a hatching season.

The three main artificial properties required for incubation are heat, moisture and ventilation.



Heat:

Heat must be uniformly applied to every egg in the machine. It should be consistent in temperature, due allowance being made in the regulator adjustments in order to compensate for outside fluctuations in temperature.

While desiring an even heat of 102 deg. over a period of 28 days, the operator may by experience find it necessary to make modifications. Generally, for the first week keep the temperature at 101½ deg., 101½ deg. second week, and it may rise to 102 deg. during the third week and 103 deg. during the fourth week. No set rule can be applied. Different incubators need modified applications of the general principles.

Scientific experiments have proved that slight departures from the general principles will not damage the hatch.

Moisture:

The egg contains sufficient moisture to efficiently hatch the chick, but our methods tend to withdraw the moisture from the egg. It is therefore necessary to overcome the deficiency by applying moisture to the machine. During incubation some moisture in the egg is evaporated and some absorbed by the growing embryo.

It has been found necessary to apply extra moisture when hatching duck eggs. One will notice that any sitting duck will always bathe before returning to the nest. Her feathers must naturally have particles of water attached to them when she immediately returns to the eggs.

In practice it has been found that the damping of the eggs night and morning with a very damp flannel rag has an excellent effect on retaining the moisture content of the egg.

Dip the rag into warm water, wring out and brush to and fro across the eggs until they are dripping wet. Replace eggs in the tray. Start this procedure seven days after setting and discontinue four days before the hatch is due.

Ventilation:

Moisture is largely controlled by the rate of ventilation. Too excessive ventilation causes excessive withdrawal of moisture. Too little ventilation causes an accumulation of foul air. We must therefore be sure that while the ventilation is sufficient to keep the air pure it is not so fast as to withdraw moisture excessively.

Moisture and ventilation are closely related. Moisture can be added to the air by the addition of water trays inside the egg chamber, but again one must be careful in not making the air too moisture laden.

The fine adjustments of heat (which also causes evaporation), ventilation and moisture are absolutely necessary for a good hatch.

Operating of Incubator:

The machine must be level in all directions, or the heat will be uneven. The lamp must be filled each day and the wick trimmed. Use only the best of oil and always trim the lamp after handling the eggs; kerosene is fatal to the embryo.

The wick is trimmed by rubbing with the finger and pressing down the corners. Obtain a flame which when extended shows an even height with corners rounded. Take no chances on this, perseverance is essential for this operation. An uneven flame is the cause of trouble which comes at the most unexpected times. Keep the heater clean. Proper wick trimming is the best preventive of smoke and soot.

Gradually heat up the egg chamber—by trying to rush this process one causes smoking of the lamp, and this needs cleaning again thoroughly before one can operate successfully. A soot-covered heater is a source of lost heat.

When filling the trays place the eggs in rows irregularly spaced, big end uppermost, inclined at 45 deg. This allows of a full machine after the "clear" eggs are tested out at seven days, when the eggs left should rest on their sides.

The placing of the cool eggs inside the chamber will cause a cooling effect. Allow from 12 to 36 hours to raise the temperature to normal. This slow heating of the eggs is an advantage. Speedy raising to 102 deg. has a detrimental effect on the embryo.

Keep the temperature uniform at all times, and the eggs should begin to hatch about the beginning of the 24th day, the hatch being completed by the evening of the 28th day. Should the hatch be earlier, too great a temperature has been applied, and should the hatch take longer than 28 days, the temperature has been too low.

Do not disturb the eggs for four days, after which they should be turned and cooled twice daily until the evening of the 24th day, after which they are left alone until the hatch is completed. In turning, take care that the position of all the eggs is changed. This should be accomplished without jarring. Remove the tray from the incubator and place it on a bench which will not allow a draught to come through the eggs. Remove a row of eggs and turn the remainder with the palm of the hand. This turning shifts the position of the embryo so that it cannot adhere to the inner membrane of the shell; any that adhere will die. When turning, change the position of the eggs on the tray; replace the row and then return the tray to the machine.

The cooling is accomplished during the turning process, but as the chick develops, longer cooling is necessary. No set time can be stated, but a good guide is the back of the hand. Disregard the outside temperature, but cool sufficiently until the eggs give off a slight warmth when the back of the hand is applied. At times even one hour is required. This cooling "dries down" the air cell, and it is this drying down of the air cell which gives the operator an idea as to how his machine is operating.

When turning and cooling keep the doors of the incubator closed. On replacing the eggs the temperature of the chamber is lowered. This will right itself without any alteration to the flame or regulator. Test the eggs at the seventh day for fertility. An infertile egg will show clear.

Dead germs show in several ways. Those which have not been turned properly show as a dark spot on the inside of the shell, others show as circles of blood on the shell. Addled eggs show irregular shapes of shadow formations.

The living germ will always show a colour which is definitely impregnated with deep red. As the embryo develops, the air cell increases until it has assumed a size of nearly one-third of the egg. This is about the 23rd or 24th day.

Such increases in size of the air cells are a most important phase of incubation. It is the gauge to ventilation and moisture. Should it not develop one must increase ventilation. Too great a development is overcome by decreased ventilation or added moisture.

The normal place for the air cell is in the large end, but it may appear in other positions. A second and third testing are advisable at the 14th and 21st days; one then removes all dead embryo. The remaining eggs are left to hatch. More frequent testings may be made, as it is detrimental to have dead germs in the incubator. The pure air only is wanted.

Towards the completion of the hatching period the animal heat generated by the living embryo will cause an appreciable rise in the temperature in the egg chamber. While instruction books suggest no re-adjustment, it is advisable to keep lifting the damper as occasion demands. When resetting take care to re-adjust the regulator.

Close the machine on the evening of the 24th day and do not interfere with the hatch until the end of the 28th day. All chicks not hatched should not be helped in any way. They will usually be a loss and the first loss is preferable.

At the end of the 28th day remove the tray and leave all hatched ducklings inside the machine until they are fully fluffed out. Gradually reduce the internal heat, particularly if there is any sign of panting in the hatching chamber. See that the air is sweet, and when desired, remove ducklings to a brooder, taking care that they suffer no chill during the process.

Brooding:

The simplest method of brooding is to allow the hen to rear her own, but when an incubator is being used one must resort to artificial means of brooding. Brooding of ducks is similar to chicks, except that the young ducks do not require as much heat as the baby chicks. The principles are the same—proper warmth, dry quarters, no overheating, no chills.

Temperature of Brooders:

The proper warmth is of utmost importance in artificial brooding. If the ducklings are chilled, they are of no value. If they are overheated, the result is generally leg weakness. Keep the heat at 85 degrees F. during the first seven days, but do not rely too much on the thermometer. Look more to the manner of the

ducklings than the regulated temperature. Make the ducklings spread out; do not tolerate their closing together. That denotes the brooder is too cold. If the ducklings gasp when spread out, the heat is too high. Never make the mistake of turning out the lamp during the day time, no matter how hot the weather may seem. One generally forgets to light the brooder lamp early enough to thoroughly warm the brooder before the ducklings retire.

Brooders that have been used previously must be thoroughly washed with carbolic acid or some other disinfectant before using on a fresh batch of ducklings. Always place sand or litter beneath the brooder, never put the ducklings on a cold floor. Cold floors cause cramp, chills and leg weakness.

When purchasing a brooder consider it only useful for holding 50 per cent. of its advertised capacity.

Placing Ducklings in Brooder:

Place the ducklings under the brooder as quickly as possible and see that they settle down quickly (this denotes correct temperature). Train them to come out for feed and go inside for warmth. This is easily accomplished by allowing only a small space in front of the brooder for feeding. They can then feel the heat of the brooder and get used to going inside. When they are sufficiently knowing, take away the barrier and let them roam on nature's earth and go as far as you can afford to let them.

Fresh air and sunlight are essential to successful rearing. Cleanliness is also important. There is little danger of ailments if brooders are kept in a sanitary condition. Lack of cleanliness brings *lice* and *diarrhoea*. Do not tolerate dampness at all, dampness is a menace to health.

Do not allow ducklings to be exposed to excessive heat of the sun. It is advisable to keep young ducklings confined under intense shelter until they have completed the head feathering. Too early an exposure to the sun's strong rays will cause staggers.

High, concentrated temperature without air movement will cause *staggers*. This is very prevalent in early December. An extra hot day, warm water, very little shade, and the ducklings begin to run in circles, turn on their backs and eventually die. Keep them well away from the direct rays of the summer sun until about 8 or 9 weeks of age.

Feeding of Ducklings:

The same practice in chick feeding is found possible with ducks, except that grain is not given at the evening meal. Feed hourly during the first two weeks with a mash of 4 bran, 4 pollard, ½ meatmeal, ¼ bonemeal, 1 oilcake and 1 per cent. salt and chopped greens added, or use 5 bran and 3 wheatmeal in place of the pollard and bran—bulk measurements. Greens can be up to 50 per cent. in bulk of mash. Increase the periods between feeds as they get older but do not stint the food. Use plenty of skimmed, separated and butter milk if available, little and often. Ducklings have small capacity and they should never be allowed to get hungry. The meatmeal and bonemeal in the ration are most necessary. We must aim to get body size and capacity in order to help high production.

Plenty of fine shell-grit and plenty of cool water must always be available. Any failure to supply these two ingredients will be detrimental to good health and good growth.

Do not forget that the duckling has small capacity and it is essential that ***young ducks be given access to food during the night.***

A duckling must never be allowed to drink before partaking of food. See that there is plenty of feed available for night feeding. Their first action when released in the morning will be to rush the drinking water. Drinking under such conditions will upset the duckling and will result in loss.

At evening feed in plenty should be left over in order that the ducklings can partake of food during the darkness, and the drinking water should also be available.

Working on these lines the poultry farmer will have little trouble in rearing his ducklings.

The water troughs for young and old must be deep enough for them to bury the head under the water.

Separate the sexes as soon as possible. Young ducks will then thrive better. All unwanted males should be marketed as soon as possible. In the case of Runners and Khaki Campbell drakes, very little is received when sold for flesh but any retention in the hopes of higher prices will be doomed to disappointment. Runners and Khaki Campbell drakes, although considered a delicacy, are not paid for as such.

Except for the wheat feed at evening, laying ducks are fed the same rations as for fowls, but remember that whereas the meatmeal incorporated in the morning mash for fowls is in such proportions as to balance the wheat at evening, one must not feed the same proportion of meatmeal in the mash when feeding ducks for laying purposes. If one gave three meals a day containing a poultry mash ration one would be overdoing the meatmeal. The proportion must be lower for laying ducks, so much lower for each individual meal that each meal is a balanced ration. It has no wheat to assist in breaking down the percentage of protein in the mash.

As the ducks are reaching maturity break them from expecting a mash at midday. Alter the ration gradually by giving wheat at midday. Some prefer soaked wheat for midday meal and others place the wheat in the drinking water. Use 1 pint of wheat to about 12 ducks. The meatmeal in the morning and evening mash should now be slightly increased in order to balance the ration of wheat.

Rations (Laying Ducks):

Morning.—Eight green feed, 5 bran, 3 wheatmeal, 1 oilcake (damp), ¼ meatmeal, ⅛ bonemeal.

Midday.—Wheat and greens.

Evening.—Eight greens, 5 bran, 3 wheatmeal, 1 oilcake, ¼ meatmeal, ⅛ bonemeal.

Another method which saves several mixings per day is to feed as for fowls in the morning and in the evening eliminate the meatmeal and bonemeal when mixing the mash. This will give quite satisfactory results and has the advantage of only one mixing in the morning instead of one for the fowls and one for the ducks. Feed then as follows:—

Morning.—Five bran, 8 green feed, 3 wheatmeal, ½ meatmeal, ¼ bonemeal, 1 oilcake.

Midday.—Wheat and greens.

Evening.—Eight green feed, 5 bran, 3 wheatmeal.

One can use 4 bran and 4 pollard in place of 5 bran and 3 wheatmeal.

Handling:

When handling runners and Khaki Campbell ducks and drakes, one must never grasp them by the legs. Such a method of catching will cause the breaking of the legs as the bird is so nervous and the bones are not strong. Grasp these ducks by the neck. It is best to force the bird to the ground by pressure on the back. This saves cruelty and is the most efficient means of capture.

Laying:

Unfortunately for the poultry farmer the laying duck is a careless individual. The eggs are in most cases laid anywhere. In the water trough is a favourite place. The eggs get soiled and are very hard to clean. The ducks generally lay all eggs before 10 a.m., most are laid at daybreak. When collected they should be cleaned immediately and a hard brush is of great assistance.

Crows and magpies are the greatest trouble one has to combat. These birds are up early and are often caught stealing the duck eggs. In order to overcome this trouble in affected areas, the ducks must be enclosed until the eggs are all laid and collected. Duck eggs do not command as great a price as hen eggs. Unfortunately the duck egg has a bad name which was caused through bad feeding and management years past. At present the duck-keeper feeds properly and markets regularly and there is no reason why a good duck egg should not be as popular as any other egg. It is certainly a case of more for the money as ducks are recognised as prolific layers of large-sized eggs.

POTATO EXPERIMENTS AT BUREKUP, 1935.

E. T. MORGAN, Officer in Charge, Potato Branch.
J. C. PALMER, Dip.Agric., Potato Branch.

Potato manurial trials were conducted on the property of Mr. C. Badham, of Burekup. The land chosen for the experimental work comprises a heavy clay loam typical of much of the potato-growing land to be found in the Brunswick, Burekup, and Waterloo areas. The area planted had been "down" with subterranean clover for a number of years, and to bring it into fit condition for the growing of potatoes, was skim ploughed in April and left rough until planting time, which took place in July. Prior to planting, the land received a good harrowing and was in excellent condition for operations.

It may be questioned why the land was only very lightly ploughed, when it is generally advocated that ploughing should be done as deeply as possible. The reason is that the land in question is inclined to be rather wet in winter, and if such land is worked deeply, say in April, heavy rains following in May and June might make it impossible to work in wet weather, which is generally experienced at planting time in July.

The fertiliser mixtures used were the same as those employed in other years in the same area.

The area was planted with "certified" large seed, cut into 1½ to 2 ounce sets; the land being ploughed to a depth of about 1½ inches and the seed pieces planted in the side of the furrow at a depth of 3 inches. The trial plots were planted from the 24th to the 27th of July and harvesting took place from the 27th to the 30th of November.

The growing conditions were ideal. Exceptionally heavy rains fell in July prior to planting, but later the weather became more congenial and rains late in October allowed of full maturity prior to harvesting.

Each fertiliser mixture was sown in plots 2½ chains long, making each plot 1 100th of an acre. Three rows of potatoes in each plot were all planted with the same manure, so that when the experiment was dug, the central row only was weighed, thereby ensuring that each manurial treatment was well isolated the one from the other, since in each 2½ chain plots the two outside rows could be regarded as buffers. Further, by the weighing of the central row only, the possibility of error due to seepage of manurial constituents from one plot to another was avoided. There were four repetitions of each manurial treatment.

* DETAILS OF MANURING PER ACRE.

A1 ...	4 cwt. S/A ...	0 cwt. Super. ...	2 cwt. S/P
A2 ...	4 cwt. S/A ...	12 cwt. Super. ...	2 cwt. S/P
A3 ...	4 cwt. S/A ...	4 cwt. Super. ...	2 cwt. S/P
B1 ...	4 cwt. S/A ...	8 cwt. Super. ...	2 cwt. S/P
B2 ...	4 cwt. S/A ...	12 cwt. Super. ...	2 cwt. S/P
B3 ...	4 cwt. S/A ...	16 cwt. Super. ...	2 cwt. S/P
C1 ...	2 cwt. S/A ...	12 cwt. Super. ...	2 cwt. S/P
C2 ...	4 cwt. S/A ...	12 cwt. Super. ...	2 cwt. S/P
C3 ...	6 cwt. S/A ...	12 cwt. Super. ...	2 cwt. S/P
D1 ...	6 cwt. S/A ...	12 cwt. Super. ...	1 cwt. S/P
D2 ...	4 cwt. S/A ...	12 cwt. Super. ...	2 cwt. S/P
D3 ...	4 cwt. S/A ...	12 cwt. Super. ...	4 cwt. S/P

The control mixture for these trials was 4 cwt. S/A, 12 cwt. super, 2 cwt. S/P, and is indicated by the figure 2 in each set.

The actual design of the experiment was to find out:—

1. The effect of varying weights of super 0, 4, 8, 12, 16 cwts. in a mixture in which the relative amounts of sulphate ammonia (4 cwts.) and of sulphate potash (2 cwts.) remained constant.

2. The effect of varying weights of sulphate ammonia 2, 4, 6 cwts. in a mixture in which the relative amounts of super (12 cwts.) and of sulphate potash (2 cwts.) remained constant.

3. The effect of varying weights of sulphate potash 1, 2, 4 cwts. in a mixture in which the relative amounts of super (12 cwts.) and of sulphate ammonia (4 cwts.) remained constant.

After the experimental area had been planted, it was hoed and cultivated to keep down weeds, and moulding up was carried out about five weeks prior to harvesting. A matter of interest is that the highest plot yield gave a return equal to 17½ tons per acre. This was obtained from the 4-12-2 mixture. Whereas from the 4-0-2 mixture the lowest return of 5 tons per acre only was dug.

* All through this paper the manurial mixtures are given Sulphate of Ammonia (S/A), Superphosphate (Super.), and Sulphate of Potash (S/P), and always in this order.

The results of the fertiliser trials are attached below:—

SUPER. SERIES.

Set.	Manuring in cwts. per acre.	Yield in lbs. per plot.	Average Yield in lbs. per plot.	Computed Yield. Tons per acre. tons.	cwt.	Percentage.
A1	4 cwt. S/A ...	165				
	0 cwt. Super. ...	175				
	2 cwt. S/P ...	155				
		125	... 155 ...	6	18	... 53
A2 (Control) ...	4 cwt. S/A ...	269				
	12 cwt. Super. ...	313				
	2 cwt. S/P ...	321				
		266	... 292 ...	13	0	... 100
A3	4 cwt. S/A ...	254				
	4 cwt. Super. ...	283				
	2 cwt. S/P ...	271				
		224	... 258 ...	11	10	... 88
B1	4 cwt. S/A ...	305				
	8 cwt. Super. ...	240				
	2 cwt. S/P ...	281				
		301	... 281 ...	12	11	... 96
B2 (Control) ...	4 cwt. S/A ...	269				
	12 cwt. Super. ...	313				
	2 cwt. S/P ...	321				
		266	... 292 ...	13	0	... 100
B3	4 cwt. S/A ...	308				
	16 cwt. Super. ...	329				
	2 cwt. S/P ...	288				
		282	... 302 ...	13	9	... 104

These results show a progressive increase of yield from 0 cwt. super per acre up to 16 cwt. per acre. There is little, if any, significant difference between 8 cwt., 12 cwt., and 16 cwt. This is a result that previous experiments have confirmed.

NITROGEN SERIES.

Set.	Manuring in cwts. per acre.	Yield in lbs. per plot.	Average Yield in lbs. per plot.	Computed Yield. Tons per acre. tons.	cwt.	Percentage.
C1	2 cwt. S/A ...	298				
	12 cwt. Super. ...	262				
	2 cwt. S/P ...	240				
		254	... 264 ...	11	15	90
C2 (Control) ...	4 cwt. S/A ...	269				
	12 cwt. Super. ...	313				
	2 cwt. S/P ...	321				
		266	... 292 ...	13	0	... 100
C3	6 cwt. S/A ...	300				
	12 cwt. Super. ...	275				
	2 cwt. S/P ...	330				
		326	... 308 ...	13	15	... 106

These results (nitrogen) show a progressive increase of yield from 2 cwt. S/A up to 6 cwt. S/A. There is significant difference between 2 cwt. S/A and 4 cwt. S/A, but no significant difference between 4 cwt. S/A and 6 cwt. S/A.

POTASH SERIES.

Set.	Manuring in cwts. per acre.	Yield in lbs. per plot.	Average Yield in lbs. per plot.	Computed Yield. Tons per acre. tons. cwt.	Per-centage.
D1	4 cwt. S/A ...	263			
	12 cwt. Super. ...	287			
	1 cwt. S/P ...	246			
		284	... 270 ...	12 1	... 83
D2 (Control) ...	4 cwt. S/A ...	307			
	12 cwt. Super. ...	291			
	2 cwt. S/P ...	316			
		391	... 326 ...	14 11	... 100
D3	4 cwt. S/A ...	296			
	12 cwt. Super. ...	270			
	4 cwt. S/P ...	301			
		289	... 289 ...	12 17	 90

These results show a significant increase of yield by increasing the manuring from 1 cwt. S/P to 2 cwt. S/P, and curiously a significant decrease of yield by increasing from 2 cwt. S/P. to 4 cwt. S.P.—a result borne out by many recent experiments.

These trials confirm previous findings that the control mixture, *i.e.*, 4 cwts. S/A, 12 cwts. super, and 2 cwts. S/P per acre, is a most satisfactory combination for the growing of the potato crop in this class of land in the South-West.

FIELD EXPERIMENTS WITH WHEAT.

YILGARN RESEARCH STATION.

I. THOMAS, Superintendent of Wheat Farming.
W. A. HUMAN, Farm Manager.

This farm is situated eight miles east of Southern Cross on the eastern fringe of the wheat belt. The rainfall for the year, together with the average for the period registrations have been recorded at the farm, is given in the following table:—

Year.	Jan.	Feb.	Mar.	Apl.	Growing Period. May.	June.	July.	Aug.	Sept.	Oct.	Total.	Nov.	Dec.	Total
1935	66	55	101	37	41	36	197	219	49	264	806	...	10	1,075
Average, 1928–35	49	50	72	108	155	139	125	141	52	83	695	56	45	1,107

Although the rainfall for the growing period this year was above the average, the incidence of the falls was decidedly unsatisfactory and the season was one of the worst yet experienced since the farm was established. The May and June rains were much below the average and most of the crop did not germinate until the second week in July. Although the total falls recorded for July and August were satisfactory for the immediate requirements of the crop, no really heavy falls were experienced, and consequently there were no reserves of moisture in the soil to meet the dry conditions which prevailed during the spring. Between the 3rd September and 19th October, only 29 points were recorded. Rains totalling over 2½ inches were experienced from the 19th-22nd October, as a result of which it was anticipated that the crops would benefit considerably, but, unfortunately, subsequent yields were not up to expectations.

The land on which the experiments were conducted had originally carried salmon gum and gimlet forest and was previously cropped in 1933. Unless the experiment required otherwise, the land was ploughed in June and July, 1934, with a disc cultivating plough, and skim-ploughed with the same implement in August. During September and again during March, 1935, it was cultivated with a spring tyne cultivator. All plots were again cultivated prior to seeding.

The results of the field experiments conducted during 1935 are shown below.

TIME FOR PLOUGHING EXPERIMENT.

To determine the effect of long summer, early winter and late winter fallowing on the resultant wheat crop.

Planted on 16th May, 1935. Germinated on 10th July, 1935. Superphosphate—112lbs. per acre.
Variety—Gluyas Early. Seed—40lbs. per acre.

Treatment.	Computed Yields per Acre. Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.	Average Yields per acre. 1935.	Percentage Yields, 1935.	Average Yields per acre, 1932–35.*	Percentage Yields, 1932–35.*
	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	%	bus. lbs.	%
Ploughed in March	7 20	7 52	8 56	7 20	9 44	8 14	97	10 51	91
„ June ...	7 44	8 16	8 24	8 56	9 4	8 29	100	11 57	100
„ July ...	7 44	8 24	8 24	9 4	10 8	8 45	103	11 7	93

* Excluding 1934.

The average results from this experiment for the years in which it has been conducted (1932, 1933, and 1935) show that the initial operation of fallowing is best carried out during the early winter.

DEPTH OF PLOUGHING.

To determine the most profitable depth to plough when fallowing for the wheat crop.

Planted on 16th May, 1935. Germinated on 10th July, 1935. Superphosphate—112lbs. per acre
Variety—Gluyas Early. Seed—40lbs. per acre.

Treatment.	Computed Yields per Acre. Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.	Average Yields per acre, 1935.	Percentage Yields, 1935.	Average Yields per acre, 1933 & 35.	Percentage Yields, 1933 & 35.
	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	%	bus. lbs.	%
Ploughed 2in. ...	10 8	9 36	9 28	8 56	9 20	9 30	99	12 46	99
„ 4in. ...	9 44	9 28	9 52	10 0	8 48	9 34	100	12 58	100
„ 6in. ...	9 4	10 8	10 8	9 44	8 40	9 33	100	12 40	98

There is no significant difference in either this year's or the average results from the plots ploughed to different depths. It is found, however, that the plots ploughed to a depth of only two inches required additional cultivation to maintain the mulch and provide a satisfactory seed bed, and, in view of this, it is more economical to plough to a minimum depth of 4 inches.

MULCHING EXPERIMENT.

To determine to what extent the cultivation of winter fallowed land is profitable during the spring and summer months.

Planted on 14th May. Germinated on 10th July. Superphosphate—112lbs. per acre.
Variety—Gluyas Early. Seed—40lbs. per acre.

Treatment.	Computed Yields per Acre. Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.	Average Yields per acre. 1935.	Percentage Yields, 1935.	Average Yields per acre, 1933–35.	Percentage Yields, 1933–35.
	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	%	bus. lbs.	%
Cultivated before seeding only ...	9 28	9 4	9 28	9 4	9 12	9 15	99	12 29	95
Cultivated in Spring and before seeding	9 28	9 28	9 28	8 56	9 20	9 20	100	13 7	100
Cultivated in Spring before seeding and after summer rains*	9 28	10 0	10 16	9 28	9 52	9 49	105	13 42	105

* Cultivated in January and March.

The results for the past year, together with the average results for three years, indicate that the extra cultivations during the summer result in an increase in yield, though when several summer cultivations are given, the extra cost of these is not offset by the higher yields obtained.

TIME OF PLANTING.

To determine the most suitable month to plant a mid-season maturing variety.

Germinated on 10th July, 1935. Superphosphate—112lbs. per acre. Seed—40lbs. per acre. Variety—Nabawa.

Planted on:	Computed Yields per Acre. Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.	Average Yields per acre. 1935.	Per-centage Yields, 1935.	Average Yields per acre, 1928–35.	Per-centage Yields, 1928–35.
	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	%	bus. lbs.	%
April 22nd	11 12	10 16	9 44	10 16	11 12	10 32	104	18 22	104
May 16th	10 24	9 28	10 16	9 44	10 32	10 5	100	17 44	100
June 18th	11 12	10 0	10 56	11 28	10 40	10 51	108	10 55	62

To determine the most suitable month to plant an early maturing variety.

Germinated on 10th July, 1935. Superphosphate—112lbs. per acre. Seed—40lbs. per acre. Variety—Gluyas Early.

Date Planted.	Computed Yields per Acre. Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.	Average Yields per acre. 1935.	Per-centage Yields, 1935.	Average Yields per acre, 1928–35.	Per-centage Yields, 1928–35.
	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	%	bus. lbs.	%
June 18th	11 36	11 28	9 28	9 4	*	10 24	102	12 51	71
May 18th	11 36	10 24	9 28	9 20	*	10 12	100	17 59	100
July 16th	7 12	8 56	6 40	5 44	*	7 8	70	6 55	38

* This section discarded.

As the April, May, and June sowings germinated together early in July, the results this year are of little value. The average results for seven years show that the best results are obtained from a mid-season variety when planted early in the season, while with an early variety, considerably reduced yields can be expected when the planting season is extended into June.

RATE OF SEEDING EXPERIMENT.

To determine the most economical rate of planting a mid-season free stooling variety.

Planted on 16th April. Germinated on 10th July. Variety—Nabawa. Superphosphate—112lbs. per acre.

Treatment.	Computed Yields per Acre. Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.	Average Yields per acre. 1935.	Per-centage Yields, 1935.	Average Yields per acre, 1931–35.	Per-centage Yields, 1931–35.
	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	%	bus. lbs.	%
20 lbs.	5 20	5 12	6 8	6 8	5 44	5 42	67	13 46	83
40 lbs.	8 8	8 16	9 12	8 32	8 16	8 29	100	16 30	100
30 lbs.	8 16	8 0	7 28	8 16	7 20	7 52	93	15 56	97

To determine the most economical rate of planting an early sparse-stooling variety.

Planted on 30th May. Germinated on 10th July. Variety—Noongaar. Superphosphate—112lbs. per acre.

Treatment.	Computed Yields per Acre. Sec. 1.	Sec. 2	Sec. 3.	Sec. 4.	Sec. 5.	Average Yields per acre. 1935.	Per-centage Yields, 1935.	Average Yields per acre, 1931–35.	Per-centage Yields, 1931–35.
	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	%	bus. lbs.	%
20 lbs.	5 12	5 36	5 28	6 24	5 52	5 42	74	13 17	87
40 lbs.	6 48	7 36	7 52	8 24	8 0	7 44	100	15 18	100
30 lbs.	7 4	7 20	7 20	7 12	7 12	7 15	93	14 30	95

The results for last season show a rather more pronounced difference in favour of the heaviest rate of seed than do the average results. The latter, however, also indicate that for both the free and sparse-stooling varieties up to 40 lbs. of seed per acre can be sown with advantage.

RATE OF APPLICATION OF SUPERPHOSPHATE EXPERIMENT.

To determine the most profitable amount of superphosphate to apply to the wheat crop.

(No. 1.)

Planted on 16th May. Germinated on 10th July. Seed—40 lbs. per acre. Variety—Gluyas Early.

Rate of Application of Superphosphate per Acre.	Computed Yields per Acre. Sec. 1.	Sec. 2.	Sec. 3	Sec. 4.	Sec. 5.	Average Yields per acre. 1935.	Percentage Yields, 1935.	Average Yields per acre, 1929–35	Percentage Yields, 1929–35.
	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	%	bus. lbs.	%
225 lbs.	14 48	13 20	13 44	14 16	14 8	14 3	110	16 45	102
150 lbs.	12 8	13 12	13 12	13 20	12 8	12 48	100	16 29	100
300 lbs.	12 16	13 20	13 44	14 0	14 32	13 34	106	16 53	103

(No. 2.)

Planted on 16th May. Germinated on 10th July. Seed—40 lbs. per acre. Variety—Gluyas Early.

Rate of Application of Superphosphate per Acre.	Computed Yields per Acre. Sec. 1	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.	Average Yields per acre. 1935.	Percentage Yields, 1935.	Average Yields per acre, 1929–35.	Percentage Yields, 1929–35.
	bus lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	%	bus. lbs.	%
Nil	5 4	4 16	4 16	3 28	3 28	4 6	29	10 17	56
150 lbs.	14 56	15 44	13 36	13 20	12 48	14 5	100	18 14	100
75 lbs.	10 48	11 4	9 36	8 56	9 36	10 2	71	15 23	84

In 1935 the heavier rates of superphosphate showed to greater advantage than has been the case in the past. The average results for the period 1929-35 show that with the present prices which obtain for wheat and superphosphate, up to about 1 cwt. per acre can be applied with profitable results.

POTASH-NITROGEN EXPERIMENT.

To determine the effect upon the wheat crop of (a) a nitrogenous fertiliser, (b) a nitrogenous plus a potassic fertiliser.

Planted on 28th May, 1935. Germinated on 10th July, 1935. Superphosphate—112 lbs. per acre. Variety—Gluyas Early. Seed—40 lbs. per acre.

Treatment.	Computed Yields per Acre. Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.	Average Yields per acre. 1935.	Percentage Yields, 1935.	Average Yields per acre, 1933–35.	Percentage Yields, 1933–35.
	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	%	bus. lbs.	%
112 Sulphate Ammonia 112 Superphosphate	9 12	9 52	9 36	9 28	10 40	9 46	98	16 2	98
112 Superphosphate	9 20	9 20	9 20	10 0	11 52	9 58	100	16 22	100
112 Sulph. Ammonia 112 Superphosphate 56 Muriate of Potash	9 4	9 12	9 12	10 0	10 32	9 36	96	15 58	97

The results for last season are in agreement with the results of previous years in demonstrating that increased yields cannot be expected following the application of a nitrogenous or a nitrogenous plus a potassic fertiliser.

SEASONAL PLANTING EXPERIMENT.

To ascertain the most suitable month to plant the mid-season, early, and very early varieties of wheat and to determine the most prolific of these varieties.

April Planting.

Planted on 15th April. Germinated on 10th July. Seed—40 lbs. per acre. Superphosphate—112 lbs. per acre.

Variety.	Maturity.	Computed Yields per Acre. Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.	Average Yields per acre, 1935.	Percentage Yields, 1935.	Percentage Yields, 1932–35.
		bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	%	%
Noongaar ...	Very Early...	11 4	11 36	11 52	9 52	12 32	11 23	101	72
Gluyas Early...	Early ...	11 36	11 20	11 52	10 16	11 20	11 17	100	100
Totagdin ...	Early ...	12 0	11 52	12 8	11 20	12 24	11 57	106	104
Bencubbin ...	Mid-season ...	12 48	12 24	12 0	12 16	13 36	12 37	108	110
Gluyas Early...	Early ...	11 52	11 52	11 12	11 36	12 0	11 42	100	100
Nabawa ...	Mid-season ...	10 40	11 36	10 48	12 16	11 12	11 18	97	102

May Planting

Planted on 15th May. Germinated on 10th July. Seed—40 lbs. per acre. Superphosphate—112 lbs. per acre.

Variety.	Maturity.	Computed Yields per Acre. Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.	Average Yields per acre, 1935.	Percentage Yields, 1935.	Percentage. Yields, 1932–35
		bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	%	%
Noongaar ...	Very Early...	11 52	11 4	11 4	10 0	11 20	11 4	94	82
Gluyas Early...	Early ...	12 24	12 16	12 0	11 28	10 40	11 46	100	100
Geeralying ...	Very Early ...	10 8	10 8	10 16	8 40	7 52	9 25	80	86
Merredin ...	Early ...	9 52	10 56	11 28	9 36	9 20	10 14	89	98
Gluyas Early...	Early ...	11 44	11 20	12 56	10 40	10 48	11 30	100	100
Totadgin ...	Early ...	12 8	11 44	12 16	10 16	10 24	11 22	99	106
S.H.J.	Early ...	8 24	8 32	8 56	6 56	7 4	7 58	69	84
Gluyas Early	Early ...	13 4	11 12	11 36	10 56	11 20	11 38	100	100
Carrabin ...	Early ...	9 28	9 28	9 4	9 12	9 20	9 18	80	91
Bencubbin ...	Mid-season ...	13 4	12 32	12 16	11 52	12 40	12 29	105	113
Guyas Early ...	Early ...	12 16	12 24	11 20	11 52	11 28	11 52	100	100
Nabawa ...	Mid-season ...	11 36	12 16	10 56	11 20	11 28	11 31	97	101

June Planting.

Planted on 18th June. Germinated on 10th July. Seed—40 lbs. per acre. Superphosphate—112 lbs. per acre.

Variety.	Maturity.	Computed Yields per Acre. Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.	Average Yields per acre, 1935.	Percentage Yields, 1935.	Percentage Yields, 1932–35.
		bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	%	%
Noongaar ...	Very Early...	8 40	7 52	8 40	8 0	8 32	8 21	96	102
Gluyas Early...	Early ...	8 56	8 16	8 32	8 40	9 12	8 43	100	100
Geeralying ...	Very Early ...	7 44	6 48	6 48	6 0	6 48	6 50	78	88
Merredin ...	Early ...	7 52	6 56	6 48	7 4	7 4	7 9	86	98
Gluyas Early...	Early ...	8 32	8 16	8 8	8 8	8 32	8 19	100	100
Totadgin ...	Early ...	8 16	9 20	7 52	9 4	8 32	8 37	103	108
S.H.J. ...	Early ...	5 36	5 36	6 8	5 4	3 52	5 15	61	78
Gluyas Early	Early ...	9 4	9 20	8 16	8 24	7 52	8 35	100	100
Carrabin ...	Early ...	7 4	7 36	6 16	7 12	5 36	6 45	79	86
Bencubbin ...	Midseason ...	10 8	10 40	9 44	11 4	8 16	9 58	118	114
Gluyas Early...	Early ...	8 24	8 56	8 8	9 28	7 28	8 29	100	100
Nabawa ...	Mid-season ...	7 20	9 4	7 12	8 40	7 28	7 57	94	101

Germination of the April, May, and June planted sections all took place early in July and the experiment is, therefore, of use this year only as a variety trial. "Bencubbin," both in this year's and the average results, shows to advantage and proves its suitability for dry conditions, in addition to "Gluyas Early," "Totadgin," and "Noongaar."

SAND COLIC IN HORSES.

A. McK. Clark,
Chief Veterinary Surgeon.

Reports have been received from the Wheat Belt areas, particularly the Kununoppin district, that mortalities are occurring amongst plough horses from being "sanded." This trouble is not uncommon at this time of the year through horses which have been turned out being put into work immediately following local rain. An accumulation of sand in the large intestine, being suddenly disturbed, causes irritation and consequent inflammation of the organ concerned.

This mortality can be obviated or reduced if preliminary precautions are taken by the owners. Such "sand colic" should be anticipated when horses are turned out to graze during the dry time of the year. Sand is taken into the bowels as the result of a depraved appetite and indigestion. Lack of proper nourishment will cause the former, whilst the fibrous nature of the food supply will induce the latter. There is also a tendency on the part of horses to lick up the soil in a search for salt. The accummulation of sand in the bowels will be prevented by minimising this craving. One feed a day for such horses should have the desired effect, and a little oats should be provided. Rock salt should be available at all times.

The urgent need for ploughing should be anticipated, and horses which have been turned out should be stable fed for at least 10 days prior to their being put into harness. Such a precaution will have the effect of gently removing any accumulation of sand and restoring the bowels to tone and health.

In order to treat for sand colic, early recognition of the trouble is desirable.

Symptoms.—These are recognised by the usual unthrifty condition of the horse and, later, colicky pains in the abdomen. On placing some of the manure in a pail of water and mixing thoroughly a deposit of sand will be seen in the bottom of the pail. Horses, in some cases, roll a good deal.

Treatment.—If the case is mild, bran mashes should be provided to which is added to the first one 1lb. of pure honey. Should the animal be not eating, the honey should be given as a drench with milk. Should this not have the desired effect there is a decided indication for more drastic treatment. In such cases 1 to 1½ pints of raw linseed oil should be given. This should be followed by spirits of nitrous ether ½ ounce, aromatic spirits of ammonia ½ ounce in ½ pint of water; this should be given every four hours. Should this not be available a wine-glassful of whisky should be given. In badly sanded horses great amounts of sand accumulate in the large intestine, and lie adjacent to the lower portion of the abdomen. Muscular contraction of the intestine is not sufficiently strong to remove this to the opening above so that it may be expelled. Horses in this condition have a tendency to roll on the ground. When down the removal of the sand will be facilitated by applying ropes to the legs and gently turning the animal from side to side. In addition to the treatment prescribed above soapy water enemas should be given at intervals.

It is hoped that greater attention will be paid to the risk which attends the custom of turning horses out between seasons from the ingestion of sand and subsequent mortality which is due to "sand colic."

EXANTHEMA OF CITRUS, JAPANESE PLUMS AND APPLE TREES IN WESTERN AUSTRALIA.

H. A. Pittman, B.A., B.Sc. Agr. (Hons.), Dip. Ed.,
Plant Pathologist.

The disease known as "Exanthema" occurs more or less throughout the citrus-growing areas of Western Australia. It is not infectious or due to parasitic organisms, but is a result of unsatisfactory conditions for plant nutrition. Exactly

Fig. 1.

A. Normal orange leaf.
B. Abnormally large leaf on water shoot of orange tree affected with Exanthema. This leaf was 8½ inches long.

After W. M. Carne, this Journal, March, 1926.

how it is brought about is not understood, although the ultimate cause would appear to be a deficiency of copper in the soil. It is evident that the condition is connected with the physical nature of the soil and subsoil in some cases; in others

with drainage; and yet again with an excess or deficiency of available nitrogen. Exanthema of citrus in this State occurs principally on poor, light or gravelly soils with a stiff or gravelly subsoil.

There are certain symptoms by which Exanthema on oranges may be detected even in the early stages (2). These are given so that the disease may be recognised and treatment applied before the trees become badly affected. It is a commonplace truth that it is easier to check trouble at its beginning than to attempt to revive the healthy growth of a badly affected tree:—

1. The leaves on strong water-shoots tend to be abnormally large and coarse, while the shoots have a tendency to droop outward and to grow upward at the end, forming an "S" shaped curve.

2. Young shoots develop small blister-like swellings or "gum pockets" which, if opened up, will be found to contain a clear gum. Later these gum pockets develop into longitudinal ruptures edged with rough brown, or reddish-brown, ridges, from within which yellowish or reddish gum exudes during wet weather. Once formed, the cankerous growth persists and may be found on the older branches of trees which have long since thrown off the disease.

3. Affected shoots tend to drop their leaves and to die back. The growth of laterals from the bases of the dead twigs produces a typically bunchy habit. This is increased by the fact that growth buds on affected trees frequently develop in clusters instead of twos, so that bunches of weak shoots subsequently arise (2). The development of a "multiple bud" condition is very characteristic of badly affected trees, and in the case of lemons may be the most reliable diagnostic feature. Badly affected trees show a typical die-back.

Lemon trees suffering from Exanthema rarely show any gum-formation on the branches, but longitudinal gum pockets may develop in the rind of the fruit on affected trees.

The fruit on affected orange trees is small and is frequently spotted or blotched with irregular brown markings, which become hard and dry, the skin finally splitting open.

EXANTHEMA OF JAPANESE PLUMS.

As has been pointed out by Horticultural Instructor V. Cahill in the Journal of the Department of Agriculture of Western Australia, Vol. 6 (2nd series), No. 3, pp. 388-394, September, 1929, a form of the disease known as Exanthema has been found to be fairly common on certain varieties of the Japanese plum ("Satsuma," "Santa Rosa" and "Shiro"), growing in the Darling Ranges of this State. It is largely confined to trees growing on gravelly soil with a stiff subsoil, and seems to be most frequent where the drainage is unsatisfactory. Trees growing on certain other soils are, however, subject to the disease to some extent (1).

In the case of the "Shiro" plum, the cracking of the bark and the exudation of gum takes place characteristically at the "forks" on the older branches, and for some little distance along the bases of the branches comprising the "fork," the tissues in between the various "forks" being very little if at all affected.

With the "Satsuma" and "Santa Rosa" plums, "the pathological condition affects the terminal and sub-terminal branches, as well as the trunk and larger limbs. Scaly bark appears on the young growth, while the bark and wood of the

older limbs are more severely affected. Splitting and scaling is the first sign, and as the trouble increases the branches become much disfigured with dark, gummy, elongated fissures of the bark. These commence as longitudinal cracks which extend

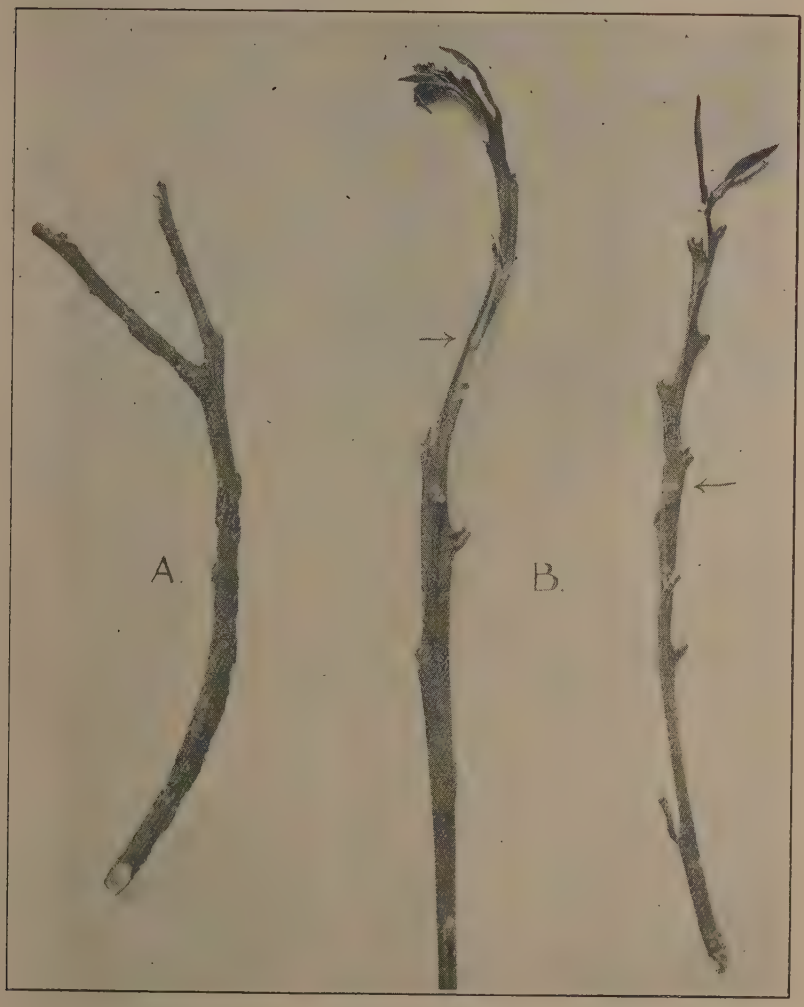


Fig. 2.

A. Branch of orange tree, showing cankerous ruptures typical of Exanthema.
B. Gum pockets on young orange shoots which eventually produce the cankerous growth shown in A.

After W. M. Carne, this Journal, March, 1926.

to the cambium layer. Later gum exudes from the ruptured tissues, giving rise to a dark, rough, irregular, reddish-brown surface. Marked dying-back of the leaders on one side or all around the tree is usually a very conspicuous feature of

the disease" (1). The soils where the condition occurs are very obviously deficient in humus.

A peculiar blistering of the bark on rapidly growing shoots of "Granny Smith" apple trees planted on poor gravelly soils has, on several occasions, been submitted to the Plant Pathology Branch for diagnosis and report. No parasitic organism was found associated with the lesions, and as treatment of the soil with bluestone, as referred to in the section on "Control" below, leads to a cessation in the development of the trouble, it is considered that this condition can also be included under the general heading of "Exanthema."

CONTROL MEASURES RECOMMENDED.

1. *Selection of Site.*—As already pointed out, Exanthema occurs principally on very shallow, poor, light or gravelly soils with a stiff or gravelly subsoil. Such soils cannot be regarded as suitable for oranges, but lemons may succeed fairly well on them. Stone fruits also may do fairly well on soils of this type. It is important, therefore, that, as far as may be possible, the most suitable site available, from a soil fertility and soil physics point of view, should be selected for the growth of each particular kind of tree being planted.

2. In California and in New South Wales a good dressing of well-rotted stable manure—about half a cartload per tree—has sometimes given good results (2). This is well worth trying here, when the manure is available, as the soils where the disease occurs are often very markedly deficient in humus. Green manure crops, and especially those of a leguminous nature, should be grown during the winter period and ploughed in (4). Any defects in drainage should also be rectified, and abundance of "well-balanced" fertiliser should be provided.

A good mixture for Western Australian conditions, *for orange trees*, as indicated by the experience of the writer, may be made by thoroughly stirring together the following materials, the proportions being by volume:—

(a) 2½ parts superphosphate;
(b) 4 parts blood and bone;
(c) 1¼ parts sulphate of ammonia:
(d) 1 part sulphate of potash.

Alternatively, the amount of blood and bone may be doubled and the sulphate of ammonia excluded, or vice versa, but the figures for the superphosphate and sulphate of potash should remain unchanged. One ounce of this mixture broadcast over a square yard of soil and then cultivated, harrowed, or dug in, should be applied several times during the late winter and spring at monthly or two-monthly intervals. One ounce of the mixture per square yard equals approximately 3 cwts. per acre.

For *lemon trees* and also for *stone fruit trees and other deciduous trees such as apples*, the following formula will generally be found satisfactory, the proportions again being by volume: —

(a) 2½ superphosphate;
(b) 2 parts blood and bone;
(c) ⅝ parts sulphate of ammonia;
(d) 1 part sulphate of potash.

Here again, (b) may be excluded and (c) doubled, or vice versa, but the figures for (a) and (d) should not be varied. (The above mixture has also been found very valuable by the writer for most flower-garden plants such as Iceland poppies, ranunculi, anemones, stocks, African and English marigolds, daffodils, jonquils, chrysanthemums, etc., when grown on the poor Perth sand.)

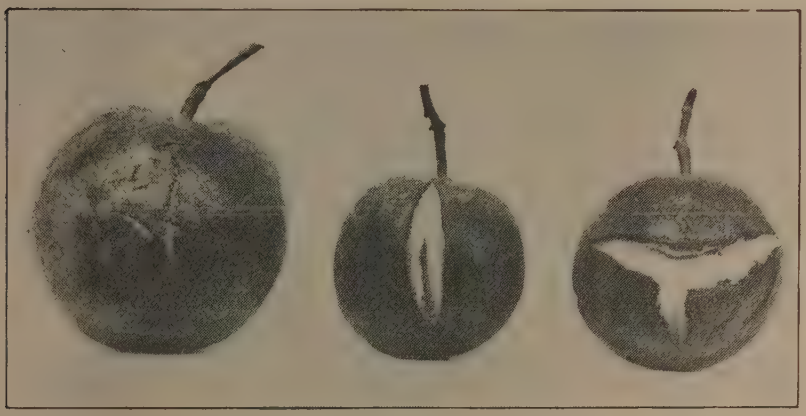


Fig. 3.—Oranges badly affected with Exanthema.

After W. M. Carne, this Journal, March, 1926.

(3) It has been found, as the result of experience in Western Australia, as well as in other parts of the world, that very favourable results in controlling Exanthema frequently accrue from the use of copper-containing sprays (1, 2, 3, 5). One spraying, of *citrus trees*, with home-made Bordeaux Mixture 4-4-40 or 4-4-50, applied in the autumn or spring, as for the control of Brown Rot (*Phytophthora citrophthora* and *P. hibernalis*), or Anthracnose (*Colletotrichum gloeosporioides*), (see Journ. Department of Agriculture, W.A., Vol. XI. (2nd series), No. 3, September, 1934, pp. 488-506 or Leaflet No. 426), appears to be adequate in controlling Exanthema for a year or so, in most cases. For *stone fruits and apples*, a similar spraying given just at the time of the breaking of the dormancy of the trees (not later for fear of causing injury to the leaves, blossom buds, etc.), or even during the winter months, frequently has a beneficial effect.

4. Experiments on citrus trees carried out some years ago, by the Superintendent of Horticulture, Mr. G. W. Wickens, showed that great benefit might be obtained by the use of copper sulphate on the soil (6). In severe cases, in addition to spraying as recommended in the previous section, apply, for well-grown trees, a dressing of 2½ to 3lbs. of finely powdered bluestone (sulphate of copper) to the soil around the base of the tree in the autumn, shortly after the commencement of the autumn rains (1, 3, 5, 6). Bluestone "fines," "snow" or "neige" is very useful for this work, as it requires no additional grinding, being already in the form of very fine crystals, somewhat like crystallized sugar, except for its blue colour, when purchased. The bluestone should be applied evenly from a foot or so away from the trunk of the tree, all round the tree under the "spread" of the branches, and extending to several feet in radius beyond the ends of the most wide-

spread branches. It should then be harrowed, cultivated or dug in, and be dissolved by watering with a hose, or be left to be carried down by the rains. Smaller quantities than those referred to above should be used for young or poorly-grown trees. The soil should always be nicely moist before the bluestone is applied.

The bluestone treatment just outlined will often lead to a complete cure, but to prevent a "relapse," an amount of bluestone equal to one-quarter of that applied in the first instance, should be applied yearly thereafter in the autumn, after the commencement of the autumn rains.

Fig. 4.—Exanthema on "Shiro" plum tree, showing the cracking open of the bark in the neighbourhood of the forks.

Photo. by Govt. Printer.

The experience which we have had in this State as to the effectiveness of bluestone in controlling the Exanthema disease, agrees with that of Smith and Thomas with Exanthema on stone, pome and other fruits in California (5) and of McCleery (3) with various kinds of citrus in New South Wales.

LITERATURE CITED.

(1.) Cahill, V.—"Experiments for the control of Exanthema in Japanese Plum Trees."—Journ. Dept. Agric., W.A., Vol. 6 (2nd Series), No. 3, pp. 388-394, Sept., 1929.

(2.) Carne, W. M.—"Exanthema—A Dieback of Orange Trees."—Journ. Dept. Agric., W.A., Vol. 3 (2nd Series), No. 1, pp. 58-62, March, 1926.

(3.) McCleery, F. C.—"Exanthema of Citrus in New South Wales."—Agric. Gaz., N.S.W., Vol. 40, pp. 397-406 and 523-533, 9 figs., 1929.

(4.) Pittman, H. A.—"Leguminous Crops and Their Place in the Building up of Soil Fertility—Necessity for the presence of Nitrogen-Fixing Bacterial Nodules on the Roots."—Journ. Dept. Agric., W.A., Vol. XII. (2nd Series), No. 2, pp. 105-116, June, 1935.

(5.) Smith, R. E., and Thomas, H. E.—"Copper sulphate as a remedy for Exanthema on Prunes, Apples, Pears and Olives."—Phytopath., Vol. 18, pp. 449-454, 4 figs., 1928.

(6.) Wickens, Geo. W.—"Exanthema of Citrus Trees."—Report of Proceedings Imperial Botanical Conference, London, 1924, pp. 353-357.

THE FARMERS' WOOL COURSE.

HUGH MCCALLUM,
Sheep and Wool Inspector.

The 1936 short course in Wool-classing for farmers was held from February 3rd to 7th inclusive. This course has proved itself to have been of high educational value to the woolgrower and has done much during the last few years to bring about the improvement of the standard of wool-classing in the farmers' clips.

This year the applications for enrolment by farmers were so numerous that the course was repeated during the following week. The arrangements for instruction were such that one half of the students were lectured by Mr. A. D. Stewart at the Perth Technical College in the mornings, while the other half received practical instruction in wool-classing from Mr. Hugh McCallum at the Wool Brokers' Stores at Fremantle. In the afternoons those who had received lectures in the morning visited the wool stores, and those who had had practical demonstrations received lectures at the Technical College.

As far as the practical instruction was concerned, the work was carried out at the four Wool Stores in the following order:—The Westralian Farmers, Ltd.; Dalgety & Co., Ltd.; Goldsbrough, Mort & Co., Ltd.; Elder, Smith & Co., Ltd. The bales on the show floors which were opened in readiness for the buyers served admirably to illustrate points, commendable and otherwise, about the classing and get-up of the wool.

Attention was drawn to several excellent examples of good even classing of farmers' clips, but for the most part the farmers' clips showed faults, some perhaps only small, which should be avoided. Among these were faulty skirting, light-conditioned fleeces mixed with heavy-conditioned fleeces, good pieces put in with locks, dusty backs left in the fleece, mixed qualities, bad rolling of fleeces, and too many dags in the locks.

Too many clips showed a wide variation of quality within the fleece. This can only be avoided by culling and breeding an even line of sheep. The odd fleece in a bale, whether yellow, matted, unskirted or tender, turns away the buyer and there

is less competition for that line. The fleece should be rolled from the breech to the neck, and the use of the old-fashioned "goose-neck" should be discontinued. Belly wool should be made as attractive as possible.

Rigid culling is the only remedy for the sheep which grows the yellow or light-weight fleece. It eats as much feed as a good sheep, so why keep it? Tick are still far too prevalent, despite the facilities offering for dipping.

Wherever it can be done, without mixing quality, length, and condition, woolgrowers should aim at making big lines because they are preferred by the buyers. In the case of the average farmer the clip is too small to permit big lines, but by the brokers' interlotting system, high prices are received for small lots. This is borne out by the fact that through one of the brokers a woolgrower received 19½d. per lb. for a line of interlotted wool at the sixth sale this season. As is often the case, the broker is unable to interlot a farmer's wool because he has classed it so badly that it will not match any of the other small lines. It is then that the broker is obliged to make a star lot of it. Needless to say, the minimum price will be realised by the wool. Sometimes interlotting is also made impossible because the owner has set too high a reserve price on his wool, and it must be sold by itself as a star lot.

In baling and branding, too, the farmer is still making errors which prevent him from obtaining the maximum price for his wool. Binder twine should never be used for sewing the bale because the hemp fibres get in the wool and are very difficult to remove. Bale clasps, such as are used by up-to-date wool farmers, are safer and easier to handle if they are put in with the help of a skewer. Branding should be done immediately after baling to avoid wrong branding. Stencils must be used to give satisfaction, and on no account should brands be put on freely with a brush. The stock brand which has numerals in it is most undesirable because the numerals are often mistaken for the number of the bale during shipping.

It is often the case that the word "fleece" is used on the bale in the wrong sense. In branding, it refers only to tender or unsound wool.

Students were shown the re-classing sections and also the processes of pressing and "dumping" bales for shipping. Good work is done by the brokers in re-classing the farmers' wool, but apart from the brokers there are the speculative buyers who buy badly classed clips at a low price, re-class them and sell them at a much higher price. This profit would belong to the grower were it not for his ignorance or negligence in classing, but in too many cases it goes to the speculative buyer.

The working of the hydraulic presses proved very interesting to the students. The space problem in shipping is largely overcome by the process of "dumping," in which the bale is reduced to approximately half its normal size with a pressure of some 3,000 lbs. to the square inch.

A visit was also paid to the W.A. Meat Export Company, where instruction was given on the treatment of export lambs and the process of scouring wool. Killing and grading was demonstrated and the disadvantages of bruising and of incorrectly tailing lambs illustrated.

On the last day of the course, the students were given a practical examination in wool-classing. There were three clips—two merino and one crossbred—and each student was given an opportunity of testing himself in each section. All work was checked, any mistakes being corrected and any queries answered. The course was concluded with a visit to the bulk classing stores where the system of working was shown and explained in detail.

The utmost courtesy was extended by the various brokers to the students, and open invitations were given them to visit the wool stores and inspect their clips when displayed on the show floors before sales.

USEFUL BIRDS OF WESTERN AUSTRALIA.

SERIES II.

THE AUSTRALIAN BUSTARD (*Eupodotis australis*).

(WILD TURKEY.)

C. F. H. Jenkins, B.A., R.A.O.U.,
Assistant Entomologist.

The Australian bustard or Wild Turkey has been aptly described as "the king of Australian game birds" and there are few sportsmen who would question the truth of this statement. Unfortunately, however, in recent years, owing to a variety of causes, the numbers of the turkey have diminished in an alarming fashion and it has lately been found necessary to add its name to the list of totally protected birds, thus excluding it from the category of legitimate game.

PLATE I.
Wild Turkey.

The name "turkey" is, of course, applied quite erroneously to this bird, the superficial resemblance which it may bear to the farmyard inhabitant being merely accorded by its large size.

The Bustard family (Otididae) is a widespread group, having representatives in Asia, Europe and Africa as well as Australia. The majority of species are large, stately birds, but unfortunately their numbers are dwindling in most parts of their habitat.

The Wild Turkey is the only species of Bustard occurring in Australia, and may be taken as a typical example of the group. The male measures about 4 feet from the tip of the bill to the tip of the tail and when walking would stand between 3 and 4 feet in height. The crown is black, the upper parts brown, and the wings spotted black and white. The female is somewhat smaller than her mate, who in the breeding season may also be recognised by a well developed throat appendage.

Although quite a good flier, the "turkey" is primarily adapted for a terrestrial existence; like the plover, stone plover or curlew and the bustard quails, the hind toe is lacking and so the bird is quite incapable of perching. A reduction in the number of toes is an adaptation common to many ground-frequenting and running birds: the three toes of the emu offer a well-known example, while in the two-toed foot of the ostrich this reduction reaches its climax.

As in the case with many Australian birds, especially those inhabiting the drier inland areas, the date of the breeding season varies greatly in different districts and in different seasons, young birds being obtainable almost any month of the year; August to November, however, may be considered the regular nesting season. The clutch consists of from one to two eggs as a rule, but three are occasionally laid. They are almost elliptical in shape and measure a little over 3 inches in length. The texture of the shell is somewhat coarse, but the surface is rather glossy. The colouring varies considerably, but the ground is some shade of brown or olive, and blotches and smears of a darker hue cover the surface.

Little or no attempt to build a nest is made, and usually the eggs are laid on the bare ground with which their colour and markings harmonise to a remarkable degree.

Quite a number of birds such as the lyre birds and the birds of paradise are famous for their powers of dancing and display during the courting season, but it is not generally known that the wild turkey also indulges in quite a ceremonious courtship preparatory to mating. An eye-witness describes the antics of the male as follows:—

> "In this peculiar attitude with bloated neck hanging, baggy chest, elevated tail and stilt-like legs, the creature struts about in a somewhat waddling manner, the elongated pouch swaying to and fro. The feathers of the throat stand out on end, those of the depending sac are also raised, but less upright. While all this has taken place, the bird seems to have gulped in the air, or rather, with partly open gape, to have taken a long, deep and forced inspiration. From time to time a deeply intoned booming note is uttered, which when heard from a distance at first simulates the distant roar of a lion."

The diet of the wild turkey is somewhat varied, but insects figure largely therein. It shows a marked liking for grasshoppers, and at times becomes so engorged with these pests that it is scarcely able to fly. Considering the menace which the latter insects alone have proved to agriculturists in various parts of Australia, it is evident that the scarcity of the turkey is a matter of regret from an economic standpoint, quite apart from sporting and scientific interests.

It is not to be insinuated that the sportsman is entirely responsible for the disappearance of the turkey in many districts, although the persistent use of the gun has been an undoubted factor in this direction. The clearing and cultivation of the land and the depasturing of sheep, in themselves, would be an important element in driving out such a bird, but perhaps the most ruthless inroads upon the turkey population have been made by the introduced fox. The breeding habits of the bustard cause brooding birds, eggs and young to fall an easy prey to this enemy of native game, and how this menace is to be coped with is difficult to say.

Although in some parts it would appear that the turkey has gone for ever, where it still remains every effort should be made to protect and foster it. The fact that the bird is totally protected by law means little unless settlers are prepared, conscientiously, to abide by the Act, but they can do more than this, for by leaving breeding grounds undisturbed where possible, and by keeping down pests such as foxes and domestic cats, not only wild turkeys, but many other useful native birds, would benefit, as indirectly would the landholders themselves.

PLATE II.
Red-tipped Pardalote.

THE PARDALOTES OR DIAMOND BIRDS.

Although amongst the most diminutive of our native birds, the Pardalotes are also amongst the most useful, whilst their plumage has been described as so variegated and beautiful as to render description impossible. The family to which they belong is restricted to Australia and Tasmania and contains seven species, five of which are represented in this State.

The commonest, although by no means the most resplendent member of the group is the Red-tipped Pardalote (*Pardalotus ornatus*). The head, wings and tail are black spotted and lined with white. The back is grey and the under parts are buff with a patch of deep yellow on the throat and upper chest. The flanks also have a yellowish tinge and a yellow stripe extends over each eye. The identification disc, so to speak, of this bird, is a small red patch on the wing, which

although scarcely discernible unless the bird is handled, is present in both sexes and clearly distinguishes the species from its near relations. This bird extends over the greater part of the continent where suitable conditions prevail, but is not present in Tasmania.

The Spotted Pardalote is another local member of the group, and like its commoner relative it is more often heard than seen, for it haunts the leafy tops of the gum trees, and frequently its clear and, to some, monotonous voice, saying "Wit-e-chu," "Wit-e-chu," alone betrays its presence.

All the Pardalotes are more or less spotted and spangled with white marks and well deserve the popular names of diamond birds or panther birds, but the species in question is probably the most strikingly coloured of them all. The head is black, spotted with white, as are the wings and tail, while a white stripe runs above each eye. The back is greyish-brown save for the rump which is bright crimson. The general colour of the under parts is buff-brown, but a rich patch of yellow marks the throat and the under tail coverts. The female can easily be distinguished from her mate for she is less vividly coloured, although more or less similarly marked. This species is the smallest member of the group, measuring a little over 3 inches in length. The Red-tipped variety exceeds this measurement by about an inch.

The food of the pardalotes consists of various tiny insects which infest the leaves and twigs of the encalypts and it is largely due to the activities of these birds that such pests are kept within reasonable bounds. In fact, the death of many fine gum trees in the park lands around Adelaide has been attributed to the diminution in numbers of such insect-eating birds as the pardalotes, which in the years gone by successfully controlled the insect pests.

The breeding habits of the diamond birds constitute one of the most interesting features of the group, a cosy grass nest being constructed either in a hollow limb or at the end of a tunnel. In the case of the Red-tipped Pardalote, the cup-shaped nest is usually built in a hollow tree spout at some height above the ground. Three to four pure white eggs are laid, measuring just under three-quarters of an inch in length.

The Spotted Pardalotte builds a spherical nest of grass with a side entrance and places it in a chamber at the end of a 12-inch tunnel drilled into the side of a bank or cutting. The construction of such a careful nest by a tunnelling bird is quite unusual, for in such cases a lining for the eggs is the nearest approach which is customarily made to nest building, and even this is dispensed with in many instances.

When orthodox nesting sites are not to hand, the pardalotes show their adaptability by making use of the material available, and the spotted variety will sometimes patronise a hollow log and the Red-tipped species in some places resorts to tunnelling or may use the deserted mud nest of the Fairy Martin or even the ventilators of dwellings and similar artificial accommodation. This adaptability is a very pleasing feature, for many of our native birds seem quite incapable of competing against the spread of civilisation, and when conditions change they are unable to accommodate themselves to the alterations.

The Pardalotes, however, seem to thrive in most places, providing a few trees are left, and this but serves to stress the importance of trees in the preservation of bird life. In the case of the Diamond birds, trees with a few dead branches are particularly suitable, for they supply ample nesting sites and serve as a home for many other useful birds, such as Tree Martins and Kingfishers.

In most of our country districts, abundant cover still remains to harbour these interesting and beautiful friends of man, but in the more sparsely timbered areas settlers should not cut out unnecessarily even half dead trees which might serve to accommodate a useful bird population.

WASTING DISEASE.

Diagnosis, Prevention, and Treatment.

J. F. Filmer, B.V.Sc.,
Senior Veterinary Surgeon.

E. J. Underwood, Ph.D. (Cantab.), B.Sc. (Agric.),
Animal Nutrition Officer.

OCCURRENCE.

Wasting disease was at one time believed to affect only young cattle and to be confined to some of the Karri slopes in the Denmark district. It is now known that sheep also may be affected, and that the disease is much more widely spread than was formerly suspected. It is known to occur in the Nornalup, Walpole, Northcliffe, and Redmond districts, and it is probably present in other parts of the South-West.

DIAGNOSIS.

In both sheep and cattle the disease is characterised by a gradually decreasing appetite until finally they almost cease to eat. Naturally the animals lose condition, and literally starve themselves to death. This may occur in the presence of an abundance of what appears to be excellent quality fodder. In cattle the lack of appetite for food is accompanied by a depraved appetite for rubbish such as bark, sticks, bones, earth, etc. The coat becomes long and rough. In young calves scouring is often noted. In cows lactation is depressed, abortion may occur, and it is difficult to get them in calf. Wasting in cows is often particularly rapid immediately after calving or abortion. In all affected animals anaemia is a pronounced symptom. Both cattle and sheep gradually become weaker, and if not treated will die from 3 months to 2 years after symptoms are first noted. The disease runs a much more rapid course in sheep and calves than in older cattle. It may occur at any time of the year, but is most common during the spring and early summer when green feed is abundant. Many diseases, for example, starvation, worms, tuberculosis, etc., may cause similar symptoms to those outlined above. The following hints may assist in determining whether a disease characterised by loss of condition is wasting disease:—

1. Wasting disease occurs in the presence of ample feed, and is most common when the feed is green.
2. Horses are never affected with wasting disease.
3. Young cattle, especially those between 6 and 18 months, are more susceptible to wasting disease than mature cattle.
4. Sheep, and lambs especially, are more susceptible to wasting disease than young cattle.

PREVENTION AND TREATMENT—LIMONITE.

Limonite, which is an iron ore, was first used to cure wasting disease in November, 1932. Since then it has proved successful in the prevention and cure of the disease in both sheep and cattle. By its use the disease in cattle has been completely controlled in the Denmark district. It is available in the form of a lick known as Denmark Lick No. 1, which has the following formula:—

Limonite—100 parts.
Di-calcic lick—40 parts.
Copper sulphate—½ part.
Linseed meal—20 parts.

For preventing the disease it should be given to cattle in the following doses:- -

1 week to 6 months—½ ounce twice daily.
6-12 months—1 ounce twice daily.
Over 12 months—1½ ounces twice daily.

Affected cattle should receive 1½ ounces twice daily, irrespective of age. The lick is palatable, and is readily taken by cattle when mixed with milk or dry feed. Sheep take it readily as a lick if it is kept dry, though it may be necessary to mix a few oats with it when it is first exhibited. In the Denmark district it is necessary for sheep to eat about 1 ounce of this lick daily. The cost of lick varies considerably in different places on account of freight. In Denmark it costs ten shillings to keep a cow healthy for a year.

COBALT.

Towards the end of 1933 it was shown that though iron is the main constituent of limonite, its curative powers were not due to this element. An extract of limonite from which all the iron had been removed proved to be just as potent as whole limonite. After a series of experiments with fractions of this iron-free extract it was proved early in 1935 that the active principle in limonite is the metal cobalt. Since then it has been shown that cobalt in amazingly small quantities will cure and prevent the disease in both sheep and cattle. One ounce of cobalt chloride is sufficient to keep 40 cattle or 200 sheep healthy for one year. The results obtained with cobalt have been equal in every way to those produced by limonite in sheep and in young cattle. Milking cows keep their condition as well on cobalt as they do on limonite, but it has been suggested by farmers that they do not milk quite so well during the summer months. It has been possible on the experimental farm to test the effect of cobalt on milk production in only two cows, neither of which was a good producer. One affected cow gave a daily average of 8.4 lbs. milk from 16-26/8/35. It then received cobalt daily, and the average production rose to 10.9 lbs. in September, 13.7 lbs. in October, 14.9 lbs. in November, 15.7 lbs. in December, and 15.1 lbs. in January. Another affected cow gave a daily average of 6.8 lbs. from 16/8 to 25/9/35. It then received cobalt, and the daily average rose to 7.8 lbs. in October, 11.0 lbs. in November, 12.5 lbs. in December, and 12.7 lbs. in January. Though the improvement in pasture during these months resulted in a general increase in milk production this did not approach the increases shown by these two cows.

The most recent experiments have shown that when cobalt is given in doses which are too small to produce the best results these may be improved by the addition of minute quantities of nickel. This suggests that the results which are obtained with larger doses may be due in fact to nickel, which is often present as an impurity in cobalt salts. It is therefore recommended that nickel be included in the solution to be used, though it is rather unlikely that it will have any effect when ordinary cobalt chloride is given in the doses prescribed.

In order to measure the extremely small doses of cobalt and nickel it is necessary to give them in a very weak solution. The following procedure should prove a practical one: Obtain from the chemist a beer bottle full of water in which 5 grammes of cobalt chloride and 1 gramme of nickel chloride have been dissolved, and a small glass jar which will hold ½ fluid ounce. Pour one small jarful of the concentrated solution into another beer bottle, fill with rainwater, and shake well. One half-ounce jarful of this dilute solution represents the daily dose for cattle of any age, and may be given in milk or sprinkled on dry feed. It is quite tasteless, but should be mixed well with the feed, as some cows object to moisture in their feed.

The beer bottle of concentrated solution obtained from the chemist contains enough cobalt to keep 7 cattle healthy for a year. One chemist has agreed to supply this quantity for one shilling.

A procedure which it is hoped will eliminate the necessity for hand feeding dry cattle is the treating of hay with cobalt solution. For this purpose two half-ounce measures of the concentrated solution should be mixed with ½ to 1 gallon of water, and sprinkled with a watering can over each ½ ton of hay as it is placed in the stack. One beer bottle of concentrated solution will be sufficient for 12½ tons of hay, and 10 lbs. of this hay contains a daily dose of cobalt.

Whether limonite or cobalt is used it is important to treat the calves from the time they are one week old, and to continue the treatment regularly throughout their lives. Experience has shown that the disease may check the growth of calves and lower the milk production of cows without causing more obvious symptoms.

GRADE HERD RECORDING.

CALF-MARKING SCHEME.

G. K. Baron-Hay,
Superintendent of Dairying.

Since the inauguration of the Grade Herd Recording Scheme in 1933, numerous requests have been received from dairy farmers—whose herds are being tested—for the inauguration of a scheme whereby the heifer calves from the highest producing cows in the herds might be marked at birth and thus identified. This identification of heifer calves would permit purchasers of young cows, in due course, to have some guarantee as to the probable production of these young stock.

It was not thought politic to introduce such a scheme at the same time that the recording of grade herds was inaugurated, for several reasons:—

(1) No accurate information existed as to the average production of cows in dairy herds throughout the South-West portion of the State, and, therefore, it was felt that there was no basis for fixing the standard of production which cows should attain before their heifer calves could be marked with a stamp of approval.

(2) It was further thought that, until herds had been under test for at least two years, it would be undesirable to commence a Calf Marking Scheme, as some cows which had commenced their lactation period late in the previous season would be handicapped by reason of their production being below what they could have produced had their lactation commenced early in autumn.

(3) It also was thought desirable that the attitude of farmers towards such a scheme should be definitely ascertained before its inauguration, particularly information as to whether farmers outside the Recording Scheme would be prepared to buy such marked heifers at a premium over heifers reared under present conditions.

The interest which the Grade Herd Recording Scheme has created amongst all dairy farmers has become so apparent that it is now thought opportune to introduce such a Calf Marking Scheme.

The standard which is required of an "approved" cow before her female progeny can be marked is 200 lb. butter fat for a cow under 3 years and 250 lb. for a cow over 3 years. It may be necessary to raise the standard, from time to time, as the average production of herds increases.

This standard may be considered by some dairy farmers to be too low, but it is thought unwise to place such a high standard for the commencing of the scheme as to mark only a very low percentage of calves. For instance, if the standard were placed at 300 lb. butter fat per cow, only the female calves from 11 per cent. of the 4,000 cows tested in 1934-35 would have been eligible, and, as half of these calves probably would be males, approximately 5 per cent. or a total of 200 calves at most could have been marked that year. This would be far too low a number even to maintain the herd strength of the farmers whose herds are being recorded.

The standard which has been set will enable approximately 50 per cent. of the cows at present under test to attain the figure which will give them the right to be called "approved" cows.

It also must be remembered that only the heifer calves which have been sired by pure bred bulls will be eligible, which will still further reduce the number of marked calves.

An "Approved" Cow
Tattooed in Right Ear, denoting Unit A, Herd B, Cow 5.

A "Marked" Calf
Tattoed in Left Ear, with same number as dam.

A "Marked" Cow
"Marked" calf A B 5 has been purchased by farmer in Unit K, is now in Herd L & N°22 in that Herd & is under test.

The rules under which this scheme will be operated are given below, and arrangments are being made to commence calf-marking immediately.

1. Heifer calves to be "marked" from "approved" cows only and having a registered pure bred sire of the same breed as the dam.
2. No calves to be marked from cows which have not completed one full testing period or have not attained the requisite standard in a lesser period than 273 days.
3. Calves will not be marked from cows which do not continue under test the year following the date of birth of calves.
4. All calves to be marked by the Official Herd Recorder on the next visit of the Herd Recorder after birth of calves.
5. Calves to be marked in the left ear with the same tattoo number as is borne in the dam's right ear.

6. The fee for marking each calf shall be 2s. payable prior to marking being effected.
7. The standard of production for an "approved" cow shall be—
   (a) 200 lb. butter fat for cow under 3 years of age.
   (b) 250 lb. butter fat for cow over 3 years of age.
   Such butter fat shall be produced during one continuous period of not more than 273 days.
8. A certificate for a marked calf shall be made out by the Grade Herd Recorder and handed to the owner at the time of marking. This certificate to be made out in duplicate and to be regarded as a receipt.
9. The duplicate certificate shall be forwarded immediately to the Superintendent of Dairying.
10. On attaining maturity and on entering test, each marked calf shall be allotted a testing identification number which shall be tattooed in the right ear. Such marked calf shall then be known as a "marked cow."
11. Calves from such marked cows, if these shall be approved, will carry the dam's testing number in the left ear and so on.
12. In the case of pure bred calves, the dams of which may be tested in a grade herd, no further identification will be necessary provided the calves are tattooed and registered in a Stud Book.

Fee 2s.

"MARKED" CALF CERTIFICATE.

"Mark" tattooed in Left Ear.....
Date of Birth..... Registered Brand of Owner.....
Description.....
Number of Dam.....
Name of Sire (must be Pure Bred).....
Breed of Sire.....
Production of Dam.....lbs. Milk. .....% B.F. .....lbs. Butter Fat.
Date of Inspection..../..../....

I certify that the above heifer calf is of a desirable type and has been identified as described above.
Date..../..../.... Signature of Recorder.....

Original to be handed to Owner.
Duplicate forwarded to Supt. of Dairying, Perth.

CARNIOLAN QUEENS.

Apiarists requiring Carniolan Queens in the spring are advised to place their order with the Department of Agriculture at once so as to obtain early delivery, as all orders are filled in rotation. Last season some bee-keepers did not order until late, consequently on account of the demand for Queens, and the late breeding season, they had to wait several weeks.

The price of Queens are:—Laying, but untested 7s. 6d.; select tested 20s. Reduced prices for quantities. Particulars on application to the Government Apiculturist.

The Bulletin on Carniolan Bees is being reprinted, and will be available shortly.

TREES AND SHRUBS—THEIR PLACE IN THE AGRICULTURAL DISTRICTS.

C. A. GARDNER,
Government Botanist.

Trees, apart from their aesthetic value, the functions they perform, such as shade and providing timber and fuel, are a vital necessity in all countries, especially in lands where the climate is arid, or periodically so, for in such countries they play a not inconsiderable role in the stability of the soil and the local climate, not to mention their uses in providing protection from wind or dust-storms and heat or cold.

Mulga Bush at Sandstone, showing typical mulga country. The shrub behind the tree in the foreground is Acacia linophylla—"Bogada Bush."

[*Photo. by Author.*]

To realise the truth of this statement we have only to read of what is happening in the western areas of the United States of America where, owing to economic losses, the Department of Agriculture regards the situation as one of its major concerns. It is stated that the situation there has assumed the aspects of a national calamity as the result of the severe climatic and economic conditions of the past few years. In the spring of 1934 the seriousness of the situation was manifested by the great duststorms, "Nature's own manifestation of land

disorders," which occurred in the great plains region of the United States, and which blanketed almost the entire eastern half of the country. The top soil has been removed from several localities and deposited elsewhere, sometimes on land which is practically valueless; crops were buried and other crops were blown out of the soil, while the physical distress produced is said to have contributed to a lowering of the morale of the inhabitants.

This damage is attributed to an over-extension of agriculture, whereby the country was denuded on a wholesale scale, and large areas of natural grassland turned over by the plough, exposing vast areas to the drying action of the sun and wind, thus creating breeding grounds for duststorms which remove the surface layers of the soil, radically affecting its agricultural usefulness. So serious is the position that the United States Government appropriated 528,000,000 dollars for the relief of the inhabitants of the stricken areas and, as part of a huge relief plan, a proposal has been made to plant shelter trees on about 1,000,000 acres of farm land extending through the prairie region from the Canadian border into Texas.

Acacia aneura—"Sugar Brother Mulga"—in the sandy loam on the Ashburton-Lyons River Divide, Towera Station.

[*Photo. by Author.*]

Such examples are by no means unique in the world's history. We know, for example, that certain areas of Mexico, now desert, were formerly forest regions, which by ruthless destruction became what we know them to-day. History records that the Euphrates-Tigris plain was once woodland in part, and tradition tells us that portions of eastern Abyssinia and Somaliland, now desert, were once fertile wooded regions. But it is not necessary to look so far afield, for we can see what is happening in our country, where in Western New South Wales areas have been rendered worthless through overstocking and land denudation with its consequent wind erosion, and even in Western Australia there is considerable evidence that the same factor is operating, both in the northern

pastoral areas, through overstocking and mulga destruction, and in the agricultural areas, where a removal of the soil is to be noticed in localities from which the trees have been removed over large tracts.

Wind as an erosive element is important in all regions which experience a long dry period during the seasonal cycle, so that protection from devastating winds is essential; otherwise, especially under conditions of extensive cultivation, the soil must suffer. This removal of the surface soil is a matter of great importance, since the successful growing of crops depends upon its presence. The surface layers of the soil are prepared by nature through natural weathering and by deposits of humus by plants, and are sweetened by aeration and soil organisms over very long periods; once removed its restoration can only be accomplished at great expense by artificial means, or by a long natural process of amelioration. Consequently, with the removal of the surface soil, the land loses practically all of its immediate agricultural value.

As in other parts of the world the denudation of the land in dry Australia results in water erosion, especially the erosion which results from heavy summer thunderstorms, when the loose soil is easily removed by the action of large volumes of unrestricted water flow. Such storms may have a serious action on the soil, especially where the flow is unimpeded and the soil is loosened by cultivation. One does not expect to meet with this kind of thing in the wheat belt, but an example has been observed by the writer in the Tammin district which may be representative of frequent occurrences in the drier areas; in this case by a creek of considerable length which normally flows only for a few weeks in wet seasons. Rising in granite country it traverses some miles of forest loam, and enters into cultivated land in forest soil. At the point of entry it has deeply eroded a course to a depth of six feet in what was, until recently, a barely perceptible watercourse, and it has now permanently divided a paddock into two halves. Two miles further down, in level forest country, it has formed a wedge-shaped deposit of coarse washed sand to an average depth of six inches, which has had the effect of widening the watercourse to a width of about one furlong, in which the water alters its course from season to season. About thirty acres of land have received this deposit, and are now practically useless because of it. Most of this damage resulted from a severe summer thunderstorm.

Finally, there is the loss due to salt through the indiscriminate clearing of certain lands, especially watercourses and catchment areas in certain types of country, notably Jam and York Gum country. The Grass Valley brook is an example of this type, but there are numerous cases in point. It has, in fact, been found necessary to restore the natural vegetation in many water-catchment areas, or to plant trees to minimise the risk or prevent the appearance of salt. It appears probable that some at least of these salt deposits are due to moisture evaporation; the action of tree roots is presumably to keep the moisture current below, but with the removal of the trees the upward trend of the moisture, due to capillarity, is unrestricted, and salt remains after evaporation. It is certainly not due to any power of the trees themselves to absorb salt.

THE AGRICULTURAL DISTRICTS.

The wheat-growing areas of Western Australia occupy that portion of the State which lies between the annual isohyets of twenty-five and twelve inches of rain, most of which falls between the months of April and October. It extends from the Northampton district in the north, following the isohyet of twenty-five

inches to the Jarrah country of the South-West, which marks its western boundary, and from there to the sandy areas of the southern districts. The eastern limits are determined by the amount of rainfall received in the growing season, and are limited by the annual twelve-inch isohyet. The natural vegetation of the zone is of a hardy nature, since it has to contend with a dry, warm season of five, six or seven months, during which no rain may fall. It is thus obvious that any planting scheme for farms must employ trees and shrubs which require little moisture, which do not transpire freely, and are thus hard-leaved or have much reduced leaves, or they must be plants with deeply developed rooting systems. The native trees do not of necessity have deep rooting systems, but if the rooting system is shallow, the leaves are narrow and hard, as in many species of Acacia.

Mulga country, showing "Sand Mulga," Sandstone, W.A.
[*Photo., by Author.*]

It follows, therefore, that the plants selected for a planting scheme must be either those which are native to the region, and thus capable of withstanding the severe conditions, or they must be extremely hardy exotic plants which have proved of value under local conditions. The larger trees of the zone under discussion are in themselves not very suitable for windbreak purposes when fully grown, unless grown in association with shrubs, or unless a rotational system is employed in which the older trees are flanked by younger trees. The reason for this is quite obvious if one considers the average Eucalyptus tree. The Eucalyptus trees are characteristically long-stemmed, erectly branched and umbrella-topped trees, demanding light for their development, and thus when grown in close association, tall-stemmed. The flat or convex crown usually consists—in the fully grown tree—of a single layer of leafy twigs, offering the least possible resistance to the dry winds which prevail during the dry summer period of the year. This habit also prevails to a great extent amongst the shrubs also, and is one of nature's plans for resisting the drying effects of wind, while offering a maximum surface of foliage to the light.

The trees when grown with sufficient space between them often develop an entirely different habit of branching, the side branches of the young tree persisting until maturity, so that the isolated tree presents a more attractive outline. In planting trees for ornamental purposes this should be borne in mind, but in this connection a group of two or three trees may be considered as one tree from this point of view. On the other hand, where shelter trees are to be established for windbreak purposes, it is necessary that they be planted in close formation, and then it is essential for the purpose that shrubs be included to provide ground protection.

The exotic species which are likely to prove of value are limited in number, and include such species as Agave, Yucca, Prosopis (Algaroba), Schinus (pepper tree), Leucena glauca, Artemisia (wormwood), and Cortaderia selloana, the "Pampas grass," which is suitable for sandy soils.

Amongst the numerous native species, those which are particularly important include Salmon Gum, Gimlet, York Gum, Blue Mallet, Brown Mallet, Sandplain Mallee, the various species of Callitris and Actinostrobus (known as native cypress), Jam, Manna Wattle, Sheoaks, Kurrajong, numerous species of Acacias, especially those of low-branching habit, Grevilleas, and species of Melaleuca, of which many occur in every area, and are known as Tea trees.

TREES AND SHRUBS SUITABLE FOR THE AGRICULTURAL AREAS.

Acacia acuminata Benth.—The Jam or Raspberry Jam tree is a species occurring naturally in the light loamy soils derived from granite, this rock usually underlying at a shallow depth the soil in which the tree grows. It is not a deeply-rooted tree, but is quick in growth, and very drought-resistant. It attains a height of 25 feet, and has a short erect trunk and numerous branches with graceful, often drooping branches. The leaves (phyllodia) are narrow and pendulous on the older trees, although sometimes erect, and vary considerably in width. The flowers are yellow, and borne in numerous cylindrical spikes during August and September, and the pods and seeds are valued as summer feed for sheep. The wood is extremely tough and durable, and, perhaps more than any other tree is resistant to attacks from white ants, a fact that makes the species almost invaluable for ground work, such as fence posts, and stacking poles. The plant grows readily from seed, and germination is facilitated by placing the seeds in almost boiling water for about half an hour immediately before planting. The tree takes about fifteen years to attain an average height, and will provide fence posts in twenty years. Regeneration of depleted areas may be accomplished by providing a light running fire over the area in summer, and fencing the area against rabbits, since these animals are partial to the young plants.

The Jam tree should be grown in groves or plantations for the purposes of shelter and windbreak, and fairly large plantations or patches should be on every farm. Naturally the country in which the tree occurs provides some natural grazing, because of the absence of scrub, and the presence of natural grasses, and these can be augmented by the introduction of Veldt grass, or Lupins, without interfering with the growth or development of the trees.

Apart from these uses, the Jam tree, unlike many species of Acacia or Wattle, is long lived, and because of its limited stature is recommended for street planting in agricultural towns. Although naturally restricted to granitic sandy loams, the tree will thrive in any class of soil with suitable preparation.

Acacia aneura F. v. M., "Mulga."—This small tree, somewhat resembling a Jam tree, but usually with horizontal branches, attains a height of slightly over 18 or 20 feet, and is native to the arid interior of Australia. It is a valuable forage plant, the foliage containing a quantity of starch and gum, and is much sought after by sheep and cattle. The wood is dark brown in colour, hard and durable, and it would make a valuable substitute for Jam in loamy soils. This species is suitable for cultivation throughout the wheat areas, and would form a useful addition to the permanent feed of any large area. It would be necessary to protect the young plants from the ravages of rabbits, and also from stock, until a height of five or six feet had been attained.

Denuded mulga country in the Murchison district. Note the dead mulga trees.

[*Photo. by Author.*]

Acacia Giraffae Willd., the "Camel Thorn" of South Africa.—Only a few of these trees are in cultivation in Western Australia at the present time. The species is one which will grow in arid districts, being a native of desert climates in South Africa, and indifferent to heat. It has a feathery foliage and large stout spines, but like so many other prickly Acacias, is relished by stock. The tree attains a height of thirty feet, although usually much less, and has a hard and durable timber. It is not recommended for areas to the south of Quairading, but is eminently suitable for the northern and eastern districts, both as an ornamental and useful species.

Acacia linophylla W. V. Fitzg., "Bogada" or "Burgedar Bush."— This mulga is a shrub native to the Murchison, and parts of the Gascoyne district, attaining a height of ten feet, although often smaller. It is the "Wandarrie Mulga" of the early Murchison settlers, and one of the most valuable forage plants of the area wherein it grows. The leaves, like those of the Mulga, are eaten by stock, but its principal value lies in its large pendulous fleshy pods which resemble small tallow

candles, and the large hard seeds which are eagerly sought after by sheep. The shrub is suitable for all red loamy soils, and apart from its uses as a browsing plant, should be excellent for windbreak purposes. It is well adapted for soils underlaid by hard subsoils.

Acacia microbotrya Benth., the "Manna Wattle," is a small tree seldom exceeding fifteen feet in height, except in the sandy loams of the Gingin and Moora districts, where it attains a height of over thirty feet. This tree is of rapid growth, attaining an average height in a period of from five to eight years, but unlike the Jam tree has a valueless, somewhat brittle wood, and a comparatively short life, rarely exceeding thirty years. Its bark, however, is rich in tannins, and has a local use. Gum is exuded from the trunk and branches in small tears or small lumps, and is a useful substitute for gum arabic, although frequently discoloured by tannin, an objection that can be largely overcome by removing the bark from the immediate vicinity of the exudations. The tree occurs in red, or sandy loams, often with Jam and York Gum, but also with Salmon Gum and Jam, or Jam and Sheoak. It requires light and space for good development, and is suitable for isolated plantings. The seeds are eaten by stock.

Acacia Nilotica Delile.—Native to Arabia, Egypt and Nubia. This species is of rapid growth, and produces a valuable gum. It is suitable for sandy and salt soils in the warmer dry areas.

Acacia Sentis F. v. M.—This species is a large shrub with dense low branching habit. Native to the northern areas of the State, it is found occurring naturally as far south as Lake Austin, and is both a useful browsing and windbreak plant, especially in the North-West. It is remarkably drought resistant, and also has a decorative value. It is suitable for close planting as a windbreak plant, and will grow on almost any class of soil. It is not recommended for the southern areas.

Actinostrobus acuminatus Parlat., "Sand-plain Cypress." This species is a small narrow conical shrub of from six to twelve feet in height with dense blue-green sharply pointed leaves and short, very dense horizontal branches. The compact habit, and dense branching from the ground upwards, make this shrub a powerful rival to *Cupressus stricta*, and render it worthy of a place in gardens. It is propagated readily from seed. The Sand-plain Cypress grows freely in yellow sand between Northampton and Watheroo, near Wongan Hills, Tammin, Kellerberrin, and Kwolyin. It requires deep free sand for its successful growth, and is of value for breakwind purposes.

Actinostrobus pyramidalis Miq., "Swamp Cypress."—This species somewhat resembles the preceding, but is of a brighter green in its foliage, and the small scale-leaves are not sharply pointed. It is taller in growth, attaining a height of about twenty feet, but is also, like its sister species, narrow and columnar. It occurs freely in sandy clay, or clay flats subject to winter inundation between Gingin and the South Coast, and is plentiful near Cannington, and other flats between Perth and Cranbrook. It grows readily from seed, and is of quick growth, attaining a height of six feet in as many years. The species is fairly salt tolerant, and will grow on the edges of sandy salt flats, or in land periodically covered with brackish water. It also survives in dry soils. It is suitable for ornamental planting, or for breakwind purposes.

Albizzia distachya (Vent.) Macbride.—This shrub or small tree is suitable for planting in almost any situation in the western parts of the agricultural districts, although it will probably prove to be a shrub in these areas. It is comparatively

short lived, rarely surviving for more than twenty years, but its rapid growth, and heavy Jacarandra-like foliage recommend it for garden planting as an ornamental subject. It is also of use for temporary breakwinds in the Great Southern districts.

Astragalus spp.—Shrubs of this genus, apart from providing gum tragacanth, have a forage value, and are hardy in arid countries in sandy soil. *A. Hyrcanus* and *A. adscendens* are useful species with a known forage value. There are also herbaceous species of value in dry countries.

Partially denuded mulga country near the Ashburton River, showing the stony soil.

[*Photo. by Author.*]

Atriplex nummularium Lindl.—The Old Man Saltbush of Central and Western Australia is a shrub of from three to eight feet in height and exceptionally hardy. It is a valuable forage plant for all classes of stock, and its dense low branching habit recommends it for breakwind or other protective functions. It is also an important species for propagation in salt soils.

Callitris.—The native pines of Australia are notable for the dry conditions under which they thrive. For windbreak purposes they are unsurpassed, and all are of decorative value. The various species are suitable for practically any class of soil, and they are rapid in growth. The larger species possess timbers which are useful because they are resistant to decay in the soil.

Callitris calcarata R. Br., the "Black Pine," native of Eastern Australia, is a tree of medium height which grows freely in poor sandy country. The timber, although knotty, is useful and durable. This tree should be suitable for general cultivation in the lighter soils of the agricultural areas.

Callitris glauca R. Br.—This tree attains a height of over sixty feet in the interior of Western Australia, and grows in red loamy shallow soil, on breakaway stony country, and also on the margins of salt lakes. It furnishes a useful timber, and is of attractive appearance. The tree should be suitable for general planting in the agricultural areas on loamy soils, especially in the vicinity of salt lakes, being apparently indifferent to small amounts of salt in the soil.

Callitris Morrisoni R. T. Baker, "Blue Cypress Pine."—This tree, which embraces a large portion of the wheat areas between Bencubbin and Narrogin, and eastwards to Southern Cross, inhabits high gravelly ironstone soils and Wodjil country. It is of rapid growth, and suitable for close planting. It is extremely hardy, and is especially suitable for breakwind purposes. The foliage has a greenish-blue cast, and the branches spread horizontally in the mature tree.

Callitris robusta R. Br., "Rottnest Cypress Pine." -A tree of 12-20 feet with a bright green foliage. It is coastal in distribution, preferring sandy ground in limestone country, but is also hardy in sandy soils generally. It is suitable for shelter and windbreaks in sandy soils.

Callitris verrucosa R. Br., "Goldfields Cypress Pine,' is a large dense shrub of 4 to 15 feet in height, with densely foliaged erect branches and bright green foliage. It is closely related to the Rottnest Cypress, and is suitable for cultivation anywhere in light sandy soils, or in granitic loams. It is an ideal species for shelter from winds, and can be grown in the driest of sandy soils. It occurs naturally in the dry red sands of the Eastern Goldfields as far north as Menzies, or in granitic soils as far south as Salmon Gums.

The native Cypress pines are particularly suitable for localities where rabbits may render the growing of other species difficult, since the foliage is not eaten by animals. They also grow in exposed situations and are of rapid growth, and can be grown in close formation. Few plants are more suitable for windbreaks, but they are easily destroyed by fire.

Capparis spinosa Linn., "Caper Bush."—This shrub is the species from which the capers of commerce are derived. It is a small straggling shrub of three to six feet in height with spiny leaf-processes, and roundish leaves. The flowers are white and scented, and the flower-buds are pickled as capers. The shrub is one suited to the driest soils, and is ornamental. It is native to Southern Europe, Africa, Southern Asia and Northern Australia, and because of its handsome flowers is worthy of a place in any garden. Sometimes the young fruits are included with the flower-buds for pickling. The plant comes into bearing about the fifth year, and is long lived. Capers are prepared by immersing the flower-buds in slightly salted vinegar, and are afterwards strained and bottled in fresh vinegar. The Caper bush will withstand light frosts, and the species is suitable for cultivation in almost any soil, although it attains its best development in soils rich in lime.

Cassia.—The Cassias, some of which provide the senna of commerce, are well represented in Western Australia, twenty-two species being native to the tropical portions of the State and the dry interior. Almost all are of decorative value, and extremely hardy, extending into very dry regions. They are suitable for garden culture as shrubs, and are readily established from seeds. They are mostly of rapid growth, and all local species are yellow-flowered. Even the common Garden Cassia (Cassia corymbosa) is quite hardy in gardens in the dry areas, and one of

the eastern goldfields species (Cassia artemisioides Gaud.), a species with silky-hairy greyish leaves, is in cultivation in America. The so-called New Guinea Cassia (C. didymobotrya) is a hardy plant of short duration native to Abyssinia, where it occurs in dry situations.

Denuded country near the Fortescue River. The soil held in dunes by the clumps of Triodia ("Spinifex").

[*Photo. by Author.*]

Casuarina (Sheoaks).

Of the twenty-four native species of the genus Casuarina, most are useful, either as timber trees, forage or browsing shrubs, or as ornamental subjects. The following are worthy of cultivation in the wheat-growing areas:—

Casuarina campestris Diels., "Tamma."—This species occurs in two forms—as a small bushy shrub of three to five feet in height, inhabiting gravelly sandy soil, or as a tall erect shrub of about fifteen feet in clay or granitic soils. Its dense habit suggests a value for the species for breakwind purposes, while the fact that the smaller forms are readily browsed upon by stock, especially sheep, makes it at once a desirable species for planting, especially on the edges of windbreak groups. It branches from the ground, thus affording accessibility to sheep, and arresting ground winds.

Casuarina glauca Sieb., "River Sheoak."—This species very closely resembles the desert sheoak, but is greener in its branchlets, and has a south-western distribution, occurring plentifully on the banks of salt streams, such as the Pallinup and other south coastal rivers, and in brackish swamps in the South-West generally. The fact that it is remarkably salt tolerant would suggest a use for the plant in cleared watercourses that have become salt owing to the removal of trees, especially in the western parts of the agricultural districts, as for example, west of Cunderdin. The species is plentiful along the Avon River and its tributaries, where it attains a height of over twenty-five feet.

Casuarina Huegeliana Miq., the "Granite Sheoak."—This tree has a wide range in the wheat-growing districts, and is found naturally in soils of a light texture, usually around granite rocks. The tree attains a height of twenty-five or thirty feet, and has bright green, somewhat pendulous branches, which are freely eaten by stock in dry periods. Its range extends from the Darling Range eastwards as far as Merredin, and northwards to Northampton. It is a symmetrical tree of rapid growth, and matures in about twenty years. It is suitable for shade purposes when grown in groves or small plantations.

Casuarina lepidophloia F. v. M., "Desert Sheoak."—This tree, which varies between fifteen and thirty feet in height, according to soil, inhabits the arid eastern goldfields districts as far north as Wiluna. It is typically found fringing the salt lakes of the goldfields districts, and will grow in salt soils, but as a larger tree it occurs on alkaline clay flats in the northern goldfields districts. The fact that it grows freely in the Mulga country indicates that it is suitable for the driest soils, especially for salt lands. Although not very attractive in appearance, it is a useful breakwind plant which is suitable for almost any class of soil.

Celtis sinensis Pers., the "Chinese Elm."—This deciduous or partially-deciduous tree attains a height of fifty feet, and has spreading branches which extend nearly to the ground. It is of rapid growth, and is a valuable browsing plant, stock being particularly fond of the foliage. The tree requires moisture in the subsoil for its successful growth, and should not be planted in localities where the subsoil is not moist at a depth of six feet. The trees are unfortunately somewhat rare in Western Australia, and should be more extensively planted. The small orange coloured berries are eaten by poultry and pigs.

Ceratonia siliqua Linn., "Carob Tree," and "St. John's Bread."—This tree, which is of slow growth but valuable for shade, windbreak purposes, and for its sweet pods, relished by all classes of stock, has proved of value in dry areas in other lands, but apparently for its successful growth it requires soils rich in lime. The plants do not reach a fruiting stage until several years old, and when young they require protection from stock and rabbits. The tree attains a height of forty feet in suitable soils, but well-grown specimens are rarely seen except in the vicinity of the metropolitan area. It is native to the eastern Mediterranean regions, where it grows in arid climates, and it is reported as being successfully raised in the Wimmera district of Victoria. The pods are rich in sugar and gum, and are exported from Crete in large quantities. The species is not recommended for cultivation in any but soils containing a considerable amount of lime; in acid soils its growth is remarkably slow.

Conospermum stoechadis Endl., "Smokebush."—This is the common smokebush of the eastern and midlands districts sandplains, thriving in deep yellow or white sand, sometimes underlaid by gravel. The shrub rarely exceeds three feet in height, and provides valuable summer browsing for all classes of stock. It is easily destroyed by cultivation, but quickly regenerates itself after fire. It grows in the driest sandy soil, and may be a useful species to introduce into the eastern sandplain country eastwards of Merredin.

Cortaderia Selloana Aschers et Graebn, "Pampas Grass." This large perennial tussocky grass with plume-like inflorescences is extremely hardy in dry sandy soils, and is worthy of trial in the western parts of the wheatgrowing districts in deep free yellow sand. The leaves are readily eaten by cattle. The species is propagated from rooted shoots.

Eucalyptus.—This large genus is represented in Western Australia by 142 species, which as either shrubs or trees, form the most conspicuous feature of the vegetation of the South-West and Eastern Goldfields, and extend in scattered distribution northwards to Kimberley. These species include our principal timber trees, while some species yield valuable tannins in their bark, and others eucalyptus oil. Owing to its wide distribution, and the habit, bark, and flowers of several, the genus Eucalyptus is important from the standpoint of useful and ornamental trees and shrubs, and no scheme of planting is complete without them. Almost all of the mallees are useful for windbreak or decorative purposes.

Fence dividing saltbush country near the Fortescue River.
Note the absence of small vegetation on the right.
[*Photo. by Author.*]

Eucalyptus astringens Maiden, "Brown Mallet."—This tree, which attains a height of sixty feet, possesses a valuable bark which is stripped for its tannin content. The trees occur naturally through the Great Southern districts between Pingelly and Cranbrook, and eastwards to beyond Ravensthorpe. It inhabits the poorest lateritic hills in the nothern areas of its distribution, but in the south it occurs freely on loamy soils. Its rapid growth, fine upright habit, and ability to form dense colonies for the first twenty years of its life, render it at once a suitable tree for close planting for breakwind purposes. It is suitable for almost any class of soil, including wodjil and ironstone country as far east as Kellerberrin, and in addition to its usefulness as a protective and shade plant, is commercially valuable because of its bark.

Eucalyptus cladocalyx F. v. M., "Sugar Gum."—This tree has proved hardy in many inland towns, and attains a height of over eighty feet under dry conditions. It is of comparatively rapid growth, and has a narrow crown of bright

green leaves. Native to South Australia and North-Eastern Victoria, it has demonstrated its ability to thrive inland as far as Merredin, provided that it receives some attention for the first two or three years, but is not as hardy as the Salmon Gum, which latter tree is even more decorative.

Eucalyptus foecunda Schau., var. **loxophleba** Benth.—The York Gum is one of the most useful trees of the agricultural areas. Its timber being particularly strong, with an interlocked grain, it serves many useful purposes on the farm where strength and durability are required. The tree is also one of the best shade-bearing of the Eucalyptus trees of the inland areas, and it is of rapid growth. In addition, it is a useful tree for planting around excavated tanks for protection against evaporation, and also for arresting the spread of salt, especially along watercourses. York Gum country in watercourses and catchment areas should never be completely denuded of this tree, since, especially when occurring with Wandoo or Salmon Gum, the soil tends to become salt. The tree is recommended for planting in granitic loams where salt appears, or in clay soil the mallee form (E. foecunda) may be planted. This mallee form is useful for windbreak purposes anywhere in the agricultural districts. The tree and the mallee both thrive on dioritic country. York Gum is a common associate of the Jam tree, and where one grows, the other can be expected to thrive.

Eucalyptus Gardneri Maiden.—The "Blue Mallet" has the habit and appearance of the Brown Mallet, but develops into a slightly larger tree, and is characterised by its bluish cast of foliage. It is even more hardy than the Brown Mallet, and can be planted in lateritic soils anywhere where wheat is grown. Its range as a tree extends along portions of the Great Southern Railway, and it is common as far east as the Oldfield River, while Mallee forms extend inland to Goomalling and Forrestania.

Eucalyptus gracilis F. v. M., "Yorrel," the Black Morrel of some settlers.—This handsome tree is deserving of planting extensively in loamy forest country. It is exceptionally hardy, and one of the best of the shade providing trees. It is perfectly at home anywhere on heavy clay soils underlaid by hard subsoil, and its natural range extends from the longitude of Cunderdin eastwards to Kalgoorlie. The species is fairly salt tolerant, and because of its narrow, glossy foliage and wide branching, is of particular value as a shade tree when grown in isolated positions. The tree is one which would be ideal for avenue planting in the streets of country towns.

Eucalyptus salmonophloia F. v. M.—Foremost in any list of agricultural gum trees is the Salmon Gum, because of its handsome appearance, warm-coloured clean bark, and its attractive green and glossy foliage. The tree has a very wide range which practically covers the whole of the wheat lands of the State, and while it finds its typical environment in heavy loamy soil, it can also be grown in the lighter granitic loams of Jam and York Gum country, and also in sand. Owing to its natural rather close growth, it produces a small umbrella-like crown at the apex of a long straight trunk, but, if grown in the open, with ample space around, it develops into a widely branched shady tree which is ideal for shade purposes. The tree has much to recommend it for street planting, and no finer species of the genus exists. The strong straight-grained timber is useful for farm work where straight poles are required.

Eucalyptus salubris F. v. M.—The Gimlet tree is almost as well known as the Salmon Gum, but its range is more restricted, and it is confined to clay soils in its natural state. It is a very decorative species with a greenish-brown thin bark, and attractive glossy foliage. Like the Salmon Gum it becomes an umbrageous tree when grown with plenty of space for its development. The young trees provide excellent poles which are angular or slightly twisted, but unfortunately do not last long in the soil.

Eucalyptus Sargenti Maiden, "Salt River Gum."—This species, which is one of the Mallets, has an appearance intermediate between a Gimlet and a York Gum. It is a spreading tree of 15 to 30 feet with a short thick trunk and narrow blue-green leaves. It inhabits sandy salt soil along the eastern branch of the Mortlock River especially at Wyola; on the said "islands" of the salt river at Hine's Hill, and on the eastern Avon River near Brookton. No more salt tolerant tree exists, and by reason of this fact alone, the tree is valuable.

Grevillea.—Several handsome species of this genus are worthy of a place in any park and garden, and in addition a number of these are hardy sand-loving plants. Mention should be made of the desert species *Grevillea juncifolia*, which inhabits the arid red sand of the East Murchison district, having large spikes of orange-coloured flowers rich in nectar; the orange sandplain *Grevillea* of the Eastern districts (*G. excelsior*), of Pine-like habit with erect stems and horizontal branches, the large flowers being terminal in wide panicle-like bunches; the two white-flowered species of the Northampton-Geraldton district (*G. annulifera* and *G. leucopteris*), which grow in dry sand and are perhaps the finest species of this large and attractive genus. *Grevillea annulifera* has large hemispherical seeds which have an almond-like flavour, and are produced abundantly at the ends of the branches.

Hibiscus Huegelii Endl.—This lilac-flowered Hibiscus has a wide range in the South-West, extending from the Murchison River to Esperance and inland to the southern portions of the Goldfields. It prefers stony soils in partial shade. A hardier plant is the red-centred Hibiscus (*Cienfugosia hakeifolia*), which inhabits the clay soils of the agricultural districts and goldfields, and is of rapid growth, but rarely lasts in cultivation for more than six years, although it is exceptionally hardy, being suitable for cultivation anywhere in the wheat-growing areas of Western Australia.

Jacksonia.—Mueller mentions that *Jacksonia cupulifera* might prove useful in dry districts, and that it is a useful browsing plant. It is native to the Northampton district, but is usually found as a tree in the more favoured sheltered and moist localities. All the species of this genus, some known under the vernacular name of "Stinkwood" are of value as browsing plants, and are worthy of encouragement, stock eating the branches freely in dry seasons when no other feed is available.

Melia Azedarach Linn., "White Cedar" or "Cape Lilac."—This deciduous tree is native of Southern Asia and Northern Australia, although not very common in the Kimberley district. The species grows on almost any class of soil, including impoverished sand, and will succeed as far east as Kellerberrin in the lighter types of soil. The tree is excellent for shade purposes, especially for situations where shade is required in summer and light in winter. The berries are poisonous to pigs, but apparently not poisonous to poultry locally, and the

species is often grown for shade in poultry runs. It is an ideal tree for street or avenue planting, since it is umbrageous, and rarely exceeds thirty feet in height. The lilac-cloured flowers are sweetly scented.

Pittosporum phillyraeoides D.C., "Weeping Pittosporum" or "Cheesewood."—This species varies from a shrub of 8-15 feet to a tree of 25 or 30 feet in height, with a light grey bark, a soft yellowish-white timber, and gracefully pendulous branches with soft green leaves which are relished by stock in the dry areas. The species inhabits a wide area of Western Australia, extending from the tropical north almost to the south coast, and as a shrub of the western coast to a large tree in the Kalgoorlie district. It grows readily from seeds, and prefers calcareous or clay loamy soils. The shrubby form of this species might easily be mistaken in the young stage for the poisonous Pituri (*Duboisia Hopwoodii* F. v. M.).

Poinciana Gilliesii Hook, the "Bird of Paradise."—This ornamental shrub having yellow flowers with scarlet stamens, proves hardy in the agricultural districts, growing without water through the driest season. It rarely exceeds four feet in height under such conditions. Its ornamental value makes it suitable for planting in gardens, and around houses. It grows readily from seed. The plant is suitable for the lighter classes of soil or for sandplain types of country.

Prosopis juliflora D.C., the "Algaroba Bean."—A small shrubby tree of 12-20 feet. It is hardy in dry situations in the tropics, but does not withstand any degree of frost. The bark is of value for tanning, and the foliage and pods are eaten by stock. This species should prove of definite value in the Gascoyne and Murchison districts.

Ricinus communis Linn., the Castor Oil Plant, occurs plentifully in sand in several coastal areas between Geraldton and Bunbury, and is one of the hardiest shrubs for sandy soils. Its easy and rapid growth, as well as its free seed dispersal and the readiness with which it germinates make it a useful plant for windbreak purposes in arid soils, but it must be remembered that, at least in coastal areas, it tends to get out of hand, and in addition it is **a poisonous plant, so that it should never be planted in places to which stock have access.** The Castor Oil plant is stated to be of value in staying bush fires, and for keeping locusts and other noxious insects from plantations. There are few plants as hardy as the Castor Oil plant that provide such a wealth of foliage, but in every case it is necessary before planting to consider its drawbacks. The shrub is freely grown in poultry runs for shade, but no cases of poisoning in fowls is on record locally.

Robinia pseudo-acacia Linn.—This tree, known as the "White Acacia," has handsome sprays of white pea-shaped flowers somewhat reminiscent of a Wistaria. It will succeed as far inland as Meckering, and in addition to being hardy it is a soil renovator and, according to Mueller, a valuable nectar producer. The roots, when damaged, emit suckers which are sometimes troublesome, especially in gardens. Plants may be grown from these suckers.

Rosmarinus officinalis Linn., the "Rosemary."—This aromatic shrub is very hardy in dry localities in almost any soil. It is already naturalised in the vicinity of New Norcia. The plant provides an essential oil which is used in perfumery and pharmacy, and the flowers are sought after by bees. The average height of the shrub is about four feet.

Santalum acuminatum (R.Br.) D.C., the "Quandong."—This tree is suitable for cultivation in any soil in the agricultural areas. It is a very attractive species, having large scarlet fruits containing large nut-like seeds. The foliage is eaten by stock, especially cattle and camels. Like the Sandalwood the Quandong is a parasitic tree, but is readily grown from seeds.

Santalum spicatum (R.Br.) D.C., the "Sandalwood."—This tree is worthy of propagation in Jam country, both as a decorative species and because of the valuable oil which it yields. The species is a root parasite, but is readily established from seeds. It is, however, as with many other species, necessary to protect the young plants from rabbits and stock.

Eucalyptus astringens Maiden—"Brown Mallet." Narrogin.

[*Photo. by Author.*]

Schinus molle *Linn.*—The Pepper Tree is native to Mexico and South America, and is sometimes known as the Mastic Tree. Few exotic trees are more hardy, the tree thriving on any class of soil, and is of comparatively rapid growth. The plants are readily raised from seed and transplanted the following year. The foliage is not eaten by stock, and is aromatic. When young the tree is very attractive, but with age the timber becomes rotten and the trees unsightly. Fine young trees can be raised from seed in six years. The Pepper Tree should not be planted in gardens or adjacent to houses, since it produces a considerable amount of litter, and few plants will grow in its shade.

Sterculia diversifolia Don., "Kurrajong."—This species, largely planted as a street tree in metropolitan and country districts is too well known to require description. It is of comparatively slow growth, but its edible foliage and its value as a windbreak tree should not be overlooked. It is also a very symmetrical species worthy of a place in gardens.

Sterculia Gregorii F. v. M., "Goldfields Kurrajong."—This native tree somewhat resembles the preceding, but its more umbrageous habit and finer leaves, together with the fact that it is rather more hardy make it a suitable tree for any soil or locality. It occurs naturally in the granitic or sandy soils, and its foliage is valued for foraging purposes.

Tamarix gallica Linn., the "Common Tamarix."—This graceful and feathery shrub is adaptable to almost any class of soil, including dry sand and saline soil. It is also at home in water. It attains a height of thirty feet, and spreads to almost as much in diameter. It grows readily from cuttings, and should be planted extensively. Few shrubs are of greater value for breakwind purposes or for arresting soil drifts. It is particularly suitable for planting along watercourses in saline soil.

Washingtonia filifera Wendl. The "Cotton Palm," native to South California Arizona, and Texas. This well known palm is very hardy, particularly in sandy soils. For its most effective use in gardens the plants should be grown in groups of three or more.

Wigandia urens Choisy.—This Mexican shrub, which has strayed from cultivation in the metropolitan area, is a particularly hardy, large-leaved species attaining a height of 8 feet or more, and particularly attractive because of its masses of purple-violet tubular flowers. The species is worthy of propagation in the lighter soils of the agricultural areas where it might succeed without attention.

Yucca angustifolia Pursh.—Few plants are more adapted to dry sandy soils than the species of Yucca, which are desert plants. They are amongst the most decorative plants of our gardens, especially when in flower with their large pyramidal panicles of white blooms. A number are in cultivation locally.

The following plants are obtainable from the Forests Department's Nursery at Hamel. Those who desire additional information should communicate with the Conservator of Forests:—

Acacia acuminata, Benth., "Jam tree."
„ Baileyana, F. v. M., "Cootamundra Wattle."
„ dealbata, Link., "Silver Wattle."
„ decurrens, Willd., "Black Wattle."
„ elata, A. Cunn., "Cedar-leaved Wattle."
„ melanoxylon, R. Br., "Blackwood."
„ microbotrya, Benth., "Manna Wattle."
„ podalyriaefolia, A. Cunn., "Queensland Silver Wattle."
„ pycnantha, Benth., "Golden Wattle."
Araucaria excelsa, R. Br., "Norfolk Island Pine."
Callitris calcarata, R. Br., "Black Pine."
„ robusta, "Rottnest Cypress."
Casuarina glauca, Sieb., "Swamp Oak."
„ suberosa, Willd., "Sheaoak."

Ceratonia siliqua, Linn., "Carob Bean."
Cinnamomum camphora, Nees & Eberm., "Camphor Laurel."
Cupressus arizonica, Greene.
„ lusitanica, Mill., "Busaco, or Portuguese Cypress."
„ macrocarpa, Hartw., "Monterey Cypress."
„ sempervirens, L., var. horizontalis.
„ torulosa, Don., "Bhutan Cypress."
Cytisus proliferus, L., "Tree Lucerne," "Tagasaste."
Eucalyptus astringens, Maiden, "Brown Mallet."
„ botryoides, Sm., "False Mahogany."
„ citriodora, Hook., "Lemon-scented Gum."
„ cladocalyx, F. v. M., "Sugar Gum."
„ ficifolia, F. v. M., "Red-flowered Gum."
„ foecunda, Schau., var. loxophleba, Benth., "York Gum."
„ globulus, Labill., "Tasmanian Blue Gum."
„ gomphocephala, D.C., "Tuart."
„ Lehmanni, Schau., "Bald Island Marlock."
„ maculata, Hook., "Spotted Gum."
„ melliodora, A. Cunn., "Yellow Box, of N.S.W. and Victoria."
„ polyanthema, "Red Box."
„ salmonophloia, F. v. M., "Salmon Gum."
„ salubris, F. v. M., "Gimlet."
Ficus macrophylla, Desf., "Moreton Bay Fig."
Grevillea robusta, A. Cunn., "Silky Oak."
Hakea laurina, R. Br., "Sea Urchin."
„ suaveolens, R. Br., "Scented Hakea."
Jacarandra ovalifolia, R. Br., "Jacarandra."
Juniperus bermudiana, Linn., "Bermuda Pencil Cedar."
Lagunaria Patersonii, Don., "Pyramid tree."
Leptospermum laevigatum, F. v. M., "Victorian Tea-tree."
Medicago arborea, Linn., "Yellow-flowered Tree Lucerne."
Pinus canariensis, C. Sm., "Canary Island Pine."
Pittosporum undulifolium, Vent., "Pittosporum."
Prosopis juliflora, D.C., "Algaroba Bean."
Schinus molle, Linn., "Pepper tree."
Stereulia acerifolia, A. Cunn., "Flame tree."
Thuja occidentalis, Linn., "American Arbor Vitae."
„ orentalis, Linn., "Chinese Arbor Vitae."

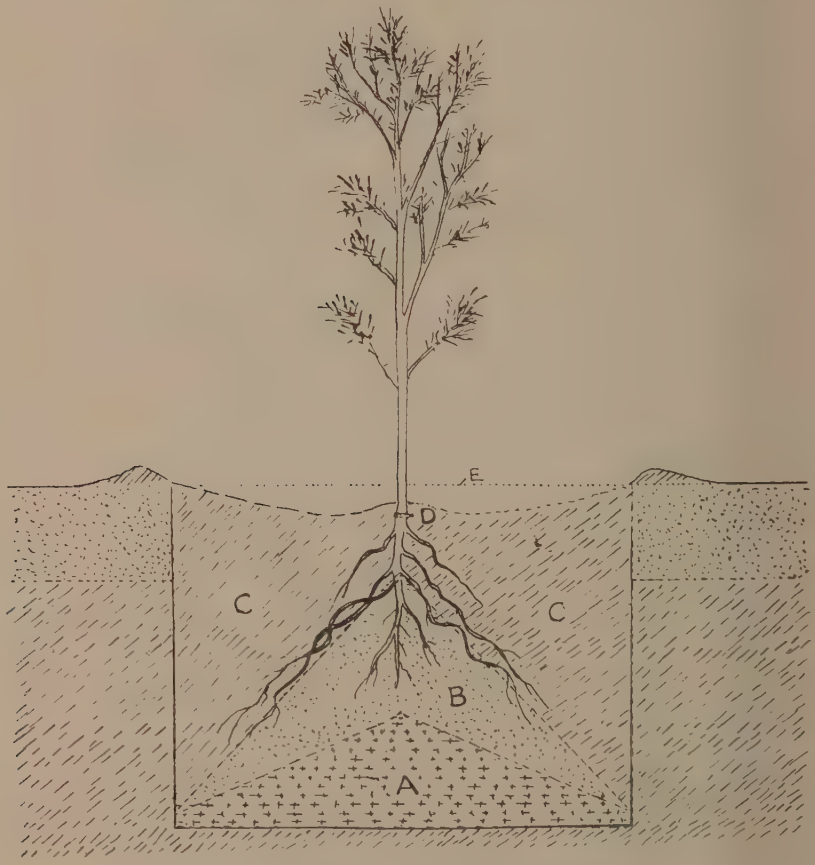
The above are procurable in trays or pots at the Hamel Nursery. In addition, there are a number of open rooted trees available, as follow:—

Erythrina indica, Lam., "Coral tree."
Melia azedarach, L., "White Cedar," or "Cape Lilac."
Pinus Coulteri, Don.
„ halepensis, Mill., "Aleppo Pine."
„ pinaster, Ait., "Maritime Pine."
„ pinea, Linn., "Stone Pine."
„ radiata, Don., "Monterey Pine."
Platanus occidentalis, Linn., "Plane tree."
Populus nigra, Linn., "Black Poplar."
Quercus lusitanica, Lam., "Portuguese Oak."
Robinia pseudo-acacia, Linn., "False Acacia."
Salix Babylonica, Linn., "Weeping Willow."
„ caprea, Linn., "Sallow, or Pussy Willow."
Stereulia diversifolia, Don., "Eastern Australian Kurrajong."
Ulmus pumila, Linn., a "Chinese Elm."

PLANTING.

In any scheme for the planting of trees, there are several important considerations involved, such as the climatic conditions of the district, the rainfall, and the soil. It follows, therefore, that only suitable trees should be planted. The trees which are briefly described in this article are in general suitable for the whole of the wheat areas unless otherwise stated, and particular attention is to be given to the texture of the soil.

The avenue system is not the most suitable for a scheme of beautification unless the ground that it traverses contains other trees. The principal objection to an avenue is that it serves practically no use as a windbreak in itself, and further, that any irregularity of growth, such as that caused by undeveloped trees, or losses due to other causes, are sufficient to destroy the effect of the avenue. Further, when trees are planted in such a conspicuous and symmetrical form, any untidiness is apt to be much more conspicuous than with a less formal manner of planting.



The correct method of planting a young tree.

A, the replaced topsoil mixed with stable manure. B, replaced topsoil. C, subsoil. D, soil level of tree when in pot. E, ground level.

For windbreak purposes trees can be grown in rows, in blocks or plantations, with regular spacing between the trees. This is perhaps the best scheme where protection from the wind is the aim in view. But even here it would be as well to try a mixture of species, say three rows of tall trees, flanked on each side by two rows of small trees, and two or three rows again on each side composed of shrubs. The trees of the middle serve as the principal protection against winds over wide areas,

while the shrubs protect the paddock from ground winds, and provide better shelter for stock. A consideration may be given to edible shrubs for the purpose, since they will then serve a dual purpose, and in the lighter types of soil the species which recommend themselves particularly in this connection are smokebush and Tamma.

For ornamental plantings the trees are best grown in well spaced and irregular groups of two to seven trees, with the tallest in the centre of the larger groups. This system appears the most natural, and allows of replacements.

Having selected the types of trees and shrubs, it is necessary to prepare the soil. In the case of isolated trees it is necessary to dig holes about four feet square and three feet deep. With hard subsoils it may be necessary to dig slightly larger holes and even to resort to gelignite to loosen the subsoil, since in such soils waterlogging may occur, which is in some cases fatal to the young plant. The first ten or twelve inches—the surface soil—should be removed and placed on one side and the removed subsoil kept apart. In the case of a poor subsoil it may be wise to add extra surface soil. A little well-rotted manure well mixed with surface soil should be placed in a shallow cone in the bottom of the hole; on the top of this the surface soil should be placed in the form of a cone, the apex of which comes practically to the surface of the hole. On this cone the young tree should be placed, and the roots spread radially outwards and downwards (if the plant possesses a tap root this should be placed vertically within the cone). The subsoil may now be placed in position, working it downwards and outwards in the direction of the roots and firmly consolidated. It is important to place the plant in a position in which the soil level is maintained with reference to the top of the hole, that is, that the surface soil level in respect to the tree is the same both when in the pot and after planting. In filling in the hole a depression should be left so that the trees can be watered without loss through overflow. The accompanying sketch will explain these points. A good soaking with water is necessary immediately, which should be repeated in the absence of rain at least one week later.

The trees should be staked and if necessary protected from wind and animals, including rabbits, fowls and stock, by means of sacking and wire netting. Sacking is practically essential in exposed situations, since the cold winter weather is frequently as damaging as the hot winds of summer.

Further watering may be necessary, depending upon the weather. When water is applied it should be used liberally in order to penetrate to the lower roots. The soil should be kept clear of weeds and other growth for the first few years.

Where trees are planted close together in large numbers it is not practicable to dig so many individual holes. The necessary cultivation may be achieved by ploughing and removing the surface soil to a depth of ten inches and then ploughing the subsoil again as deeply as possible.

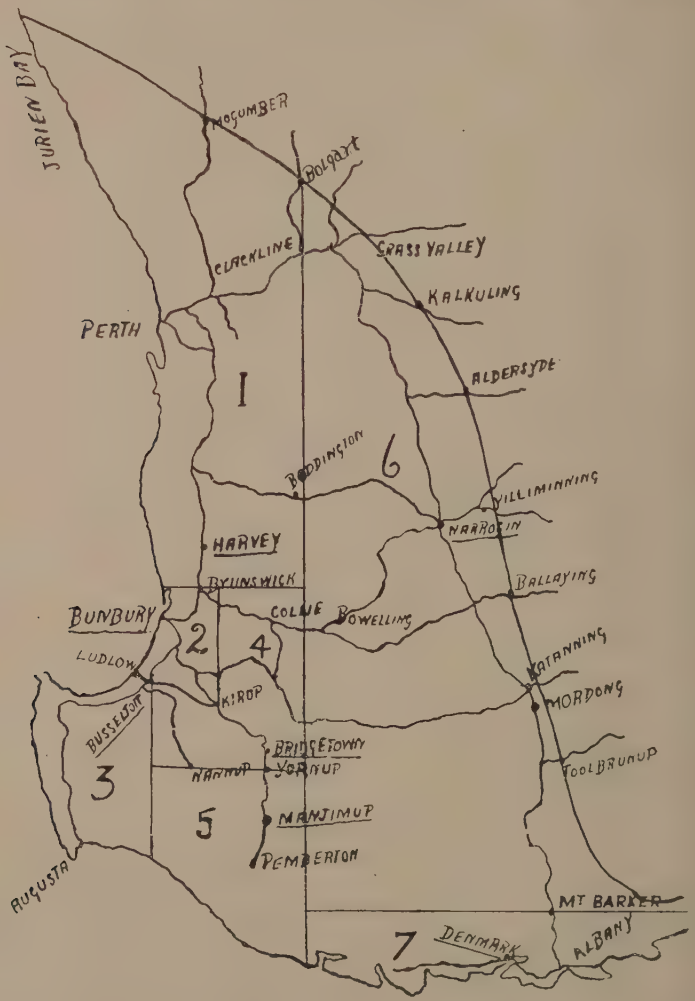
Several of the species dealt with in this article are not obtainable through nurserymen. These are in the main native plants which can be obtained directly from the bush either through seeds or young plants. In transplanting from the bush only the youngest plants should be selected, since most of the hardy species possess deep roots which are frequently six times as long as the shoot. Any injury to the main root in transplanting usually results in the death of the plant. Most native species are readily raised from seeds.

Note.—Trees and shrubs are not obtainable from the Department of Agriculture. The list of trees supplied by the Forests Department is included in this article. For other plants application should be made to nurserymen or seedsmen who may be in a position to supply many of them.

THE BETTER DAIRYING COMPETITION, 1936.

G. K. BARON-HAY,
Superintendent of Dairying, Department of Agriculture.

The Better Dairying Competition was inaugurated in 1932 by the West Australian Committee of the Australian Dairy Council, with a view to improving methods of dairy husbandry generally in Western Australia, but in particular to show the importance of fodder conservation, and to induce greater conservation.



Each year that the competition has been conducted has shown an increase in average production per cow, and an increase in fodder reserves. In addition to

this, however, a deal of statistical information has been gathered, which is a reliable guide to the returns that may be expected from this industry in Western Australia.

As in the previous five years the South-West portion of the State was divided into seven zones, as shown in the map above, and as these zones have proved most equitable to those competing, no change in these zone boundaries were made. The scale of points on which the awards were made were the same as for the previous year, as shown below:—

Scale of Points—Better Dairying Competition.

	Max. Points.
1. Conservation of Fodder and Summer Fodder Crops (300 points)—	
(a) *Hay*—Quality, Condition	60
(b) *Silage*—Quality, Type, Wastage, etc.	60
(c) *Summer Fodder Crops*—Cultivation, Disease, Yield	50
(d) Amount conserved per cow	130
2. Pastures (240 points)—	
(a) Condition, Freedom from Weeds, Mixture, Drought-resistance, etc.	150
(b) Management, Fertilisation	90
3. Dairy Herd (120 points)—	
(a) Breeding and Dairy Type	60
(b) Condition and Freedom from Disease	30
(c) Herd Sire—(i) Pure-bred	20
(ii) Ex tested Dam	10
4. Returns per Acre (120 points)—	
(a) Butter Fat, lb. per acre	100
*Sidelines	20
5. Pigs (30 points)—	
(a) Breed, Type, and Condition	10
(b) Number of breeding Sows in proportion to milch Cows ...	10
(c) Housing, Feeding and Management	10
6. Farm Management (140 points)—	
(a) Lay-out, Convenience, etc.	50
(b) Sanitation—(i) General	30
(ii) Milking Shed, Dairy, Dairy Utensils, and care of Cream and Milk	40
(c) Book-keeping and Records	20
7. Utilisation of Skim Milk (50 points)—	
Based on number of pigs reared and calf-months per cow ... ... (5 months—1 calf—1 pig)	50
Total	1,000

* Pigs, Poultry, Vegetables, etc.

The following handicaps were imposed on those competitors who gained prize-winning positions the previous year:—

First prize winner—Deduct 15 points.

Second prize winner—Deduct 10 points.

Third prize winner—Deduct 5 points.

Fourth prize winner—Deduct 1 point.

It was believed that an essential to successful dairy farming in this State was ample and highly nutritious fodder reserves. No less than 540 points out of a maximum of 1,000 was therefore allocated to the sections "Fodder Conservation" and "Pastures."

As in previous years, judging was carried out by officers of the Dairy Branch, Department of Agriculture, each zone being judged at a period so as to make the conditions as similar as possible in all zones.

Dates of judging were as follow:—

Zone 1	Centre	Harvey	... Jan. 15th to Feb. 15th, 1934
Zone 2	„	Bunbury ...	... Jan. 1st to Jan. 30th, 1934
Zone 3	„	Margaret River	... Feb. 1st to Feb. 28th, 1934
Zone 4	„	Bridgetown ...	... Jan. 15th to Feb. 15th, 1934
Zone 5	„	Manjimup ...	... Jan. 15th to Feb. 28th, 1934
Zone 6	„	Narrogin ...	... Jan. 1st to Jan. 30th, 1934
Zone 7	„	Denmark ...	... Feb. 1st to Feb. 28th, 1934

1.—Shield donated by Cuming Smith Mt. Lyell Farmers' Fertiliser Co. To be held by the zone containing the four leading farms.

The sum of money allotted to this work by the Committee of the Australian Dairy Council enabled the following prizes to be given:—

First Prize in each Zone—£10 and Framed Certificate.

Second Prize in each Zone—£6.

Third Prize in each Zone—£5.

Fourth Prize in each Zone—£1.

CHAMPION DISTRICT SHIELD.

Messrs. Cuming Smith & Mt. Lyell Farmers' Fertilisers, Ltd., in order to give a wider scope to the competition, have donated a handsome shield to be awarded annually to that district or zone containing the four leading farms. The judging for the shield is carried out by the writer in collaboration with each district judge, in order to allow for individual views of different judges.

For the 1934-35 competition the Champion Dairying Shield was won again by No. 1 Zone, with centre at Harvey, the four leading farms being owned by Mr. W. Shaw, Harvey; Mr. G. E. Scott, Yarloop; Mr. S. F. Russell, Serpentine; Mr. S. Bowers, Brunswick.

The Champion Dairy Shield has been won by the following districts:—

1932-33. No. 2 Zone; Centre—Donnybrook.

1933-34. No. 1 Zone; Centre—Harvey.

1934-35. No. 1 Zone; Centre—Harvey.

1935-36. Results not yet finalised.

Mr. W. J. Sears, Donnybrook. The use of a "tumbler sweep" for collecting clover for silage is quicker and less laborious than loading up to a cart.

The following Tables 1-6 set out the points gained by each competitor in each zone, the results being discussed in detail subsequently.

TABLE 1.

POINTS GAINED BY COMPETITORS IN ZONE 1.

Centre : Harvey Agricultural Society. Judge : C. Giles, Dairy Supervisor, Dairy Branch.

	Max. Points.	Points Allotted.																		
		S. F. Russell.	W. Shaw.	G. E. Scott.	D. D. Johnstone.	L. Temple.	Briggs Bros.	C. Peterson.	A. R. Lestar.	M. Mullens.	J. R. Giles.	J. Hill.	E. L. Marsden.	S. Bowers.	H. Piggott.	H. Eastcott.	A. Warburton.	C. A. Wickham.	Ellis Bros.	C. Paterson.
1.—CONSERVATION OF FODDER AND SUMMER FODDER CROPS— (300 points)																				
(a) Hay : Quality, Condition ...	60	48	50	46	44	44	45	45	44	48	44	50	45	46	45	45	...	44	...	45
(b) Silage: Quality, Type, Wastage, etc.	60	...	...	...	...	...	...	...	45	...	...	...	40	...	...	...	...	...	...	...
(c) Summer Fodder Crops : Cultivation, Disease, Yield ...	50	33	41	30	...	32	34	36	...	17	12	31	...	23	...	...	24	...	32	...
(d) Amount conserved per cow	130	130	130	105	66	66	80	66	51	66	87	54	24	62	66	55	67	53	66	26
2.—PASTURES— (240 points)																				
(a) Condition, Freedom from Weeds, Mixture, Drought-resistance, etc.	150	95	115	105	100	94	95	95	92	92	88	95	90	92	96	90	97	95	96	89
(b) Management, Fertilisation	90	75	79	75	72	60	70	60	70	60	52	55	55	50	55	70	52	55	52	45
3.—DAIRY HERD— (120 points)																				
(a) Breeding	60	50	52	58	54	55	52	52	50	54	50	52	48	54	52	49	50	52	52	44
(b) Dairy Type																				
(c) Condition and Freedom from Disease	30	22	30	30	28	20	24	27	24	30	26	27	24	26	28	22	27	26	27	22
(d) Herd Sire : (i) Pure-bred ...	20	20	20	20	20	19	20	19	18	20	18	19	17	19	17	20	18	20	17	18
(ii) *Ex* tested Dam	10	10	10	10	10	10	10	...	9	...	10	10	10	...	...	10	...	10	9	9

| | | |

TABLE 2.

POINTS GAINED BY COMPETITORS IN ZONE 2.

Centre: Bunbury Agricultural Society. Judge: M. Cullity, Senior Agricultural Advisor.

	Points Allotted.										
	Max. Points.	L. Field.	Norton Bros.	A. C. Frost.	R. J. Trigwell.	A. E. Jackson.	Mrs. D. B. Rose.	W. J. Sears.	T. G. and F. Hutton.	L. P. Busquets.	R. A. Clarke.
1.—CONSERVATION OF FODDER AND SUMMER FODDER CROPS— (300 points)											
(a) Hay: Quality, Condition ...	60	55	50	48	53	46	49	50	49	52	...
(b) Silage: Quality, Type, Wastage, etc.	60	55	...	...	...	...	...	...	...	...	...
(c) Summer Fodder Crops: Cultivation, Disease, Yield ...	50	40	...	...	4	32	25	10	20	30	20
(d) Amount conserved per cow	130	130	104	95	130	97	73	110	100	52	20
2.—PASTURES— (240 points)											
(a) Condition, Freedom from Weeds, Mixture, Drought resistance, etc.	150	95	140	115	95	125	120	90	100	90	114
(b) Management, Fertilisation	90	80	75	72	75	70	60	75	65	70	65
3.—DAIRY HERD— (120 points)											
(a) Breeding	60	60	55	60	47	51	48	50	44	44	46
(b) Dairy Type											
(c) Condition and Freedom from Disease	30	28	29	24	23	27	26	27	27	25	26
d) Herd Sire: (i) Pure-bred ...	20	18	16	17	14	16	17	17	18	17	12
(ii) *Ex*-tested Dam ...	10	8	...	8	...	9	8	10	5	8	8
4.—RETURNS PER ACRE— (120 points)											
(a) Butterfat (lbs. per acre) ...	100	64	71	103	40	55	67	38	32	58	37
Sidelines: Pigs, Poultry, Vegetables, etc., £.....per acre	20	14	15	19	12	9	11	4	11	5	11
5.—PIGS— (30 points)											
(a) Breed, Type, and Condition	10	7	9	9	9	9	9	8	5	7	7
(b) No. of Breeding Sows in proportion to Milch Cows ...	10	9	7	9	10	9	8	7	...	8	9
(c) Housing, Feeding and Management	10	7	8	8	10	7	10	7	7	8	9
6.—FARM MANAGEMENT— (140 points)											
(a) Lay-out, Convenience, etc....	50	35	38	38	42	40	44	40	37	41	38
(b) Sanitation:											
(i) General:	30	27	27	29	28	29	29	29	28	29	28
(ii) Milking Shed, Dairy, Dairy Utensils, and Care of Cream and Milk ...	40	25	30	33	32	29	30	31	29	32	26
(c) Book-keeping and Records ...	20	16	20	17	14	17	15	15	14	15	14
7.—UTILISATION OF SKIM MILK— (50 points)											
Based on number of pigs reared and calf-months per cow (5 months—1 calf—1 pig)	50	36	25	27	50	11	25	13	23	15	34
Total	...	809	719	733	688	688	674	636	612	606	525
Handicap	...	5	...	15	1	...	...	10			
Grand Total ...	1,000	804	719	718	687	688	674	626	612	606	525

TABLE 3.

POINTS GAINED BY COMPETITORS IN ZONE 3.

Centre: Margaret River Agricultural Society. Judge: H. G. Elliott, Agricultural Adviser.

	Max. Points	Points Allotted. A. Millar.	T. Ranson.	J. Angel.	E. C. Melville.	J. Oldfield.	C. W. Northern.	H. L. Holland.	L. A. Fenning.	V. Dawson.
1.—CONSERVATION OF FODDER AND SUMMER FODDER CROPS—(300 points)										
(a) Hay: Quality, Condition ...	60	54	54	50	53	51	52	53	49	55
(b) Silage: Quality, Type, Wastage, etc.	60	52	48	*80	†45	52	48	54	49	†35
(c) Summer Fodder Crops: Cultivation, Disease, Yield ...	50	40	35	...	40	40	30	...	...	38
(d) Amount conserved per cow	130	130	126	125	130	130	130	130	130	125
2.—PASTURES—(240 points)										
(a) Condition, Freedom from Weeds, Mixture, Drought-resistance, etc.	150	125	125*	125	130	116	120	116	116	119
(b) Management, Fertilisation	90	80	72	76	82	80	70	76	78	65
3.—DAIRY HERD—(120 points)										
(a) Breeding	60	56	49	47	56	47	44	48	46	37
(b) Dairy Type										
(c) Condition and Freedom from Disease	30	28	28	27	27	27	24	28	26	25
(d) Herd Sire: (i) Pure-bred ...	20	19	17	18	19	17	14	18	18	10
(ii) *Ex* tested Dam	10	10	6	6	8	8	8	8	6	...
4.—RETURNS PER ACRE—(120 points)										
(a) Butterfat (lbs. per acre) ...	100	86	100	87	52	80	54	90	72	49
Sidelines: Pigs, Poultry, Vegetables, etc., £..... per acre ...	20	10	20	12	14	4	9	2	7	17
5.—PIGS—(30 points)										
(a) Breed, Type, and Condition	10	8	8	7	8	8	8	8	8	8
(b) No. of Breeding Sows in proportion to Milch Cows ...	10	6	4	10	5	5	4	5	2	...
(c) Housing, Feeding, and Management	10	7	9	8	9	8	7	8	5	5
6.—FARM MANAGEMENT—(140 points)										
(a) Lay-out, Convenience, etc ...	50	40	43	38	39	45	43	40	34	30
(b) Sanitation: (i) General	30	23	24	22	25	26	23	21	20	22
(ii) Milking Shed, Dairy, Dairy Utensils, and care of Cream and Milk	40	32	32	31	32	34	31	30	25	12
(c) Book-keeping and Records ..	20	16	13	14	15	13	11	10	12	9
7.—UTILISATION OF SKIM MILK—(50 points) Based on number of pigs reared and calf-months per cow ... (5 months—1 calf—1 pig)	50	19	35	50	28	12	27	8	11	12
Total	...	850	848	833	817	803	759	745	714	673
Handicap	...	1	...	...	15	5	...	...	...	...
Grand Total ...	1000	849	848	833	802	798	759	745	714	673

* No Silage or Summer Fodder, but ample Summer Pastures.

† No Silage, but good Summer Pastures.

A stack of silage and a stack of meadow hay cut from the same area by Messrs. Bayley Bros. Denmark. Silage is cut in early October; hay cut in late November.

Fertiliser:—1 bag of superphosphate in February, 1 cwt. superphosphate end of July, also 40 lbs. superphosphate and 20 lbs. sulphate of ammonia immediately after cutting silage.

Feeding Silage. H. C. Barnsby, Clovelly Farm, Pemberton.

TABLE 4.

POINTS GAINED BY COMPETITORS IN ZONE 4.

Centre: Bridgetown Agricultural Society. Judge: K. Simes, Dairy Supervisor.

	Max. Points.	Points Allotted.							
		A. Brazier.	S. C. Maidment.	A. Tomerini.	G. E. White.	D. Scott.	A. Wright.	T. Wall.	Stapleton Bros.
1.—CONSERVATION OF FODDER AND SUMMER FODDER CROPS— (300 points)									
(a) Hay: Quality, Condition ...	60	50	57	55	48	50	50	49	45
(b) Silage: Quality, Type, Wastage, etc.	60	40	58	...	48	...	...	...	...
(c) Summer Fodder Crops: Cultivation, Disease, Yield ...	50	...	...	41	35	...	...	...	...
(d) Amount conserved per cow	130	119	130	79	60	54	28	39	49
2.—PASTURES— (240 points)									
(a) Condition, Freedom from Weeds, Mixture, Drought-resistance, etc.	150	130	92	100	95	90	100	100	90
(b) Management, Fertilisation	90	45	55	65	45	43	40	40	40
3.—DAIRY HERD— (120 points)									
(a) Breeding	60	54	53	54	50	50	50	53	48
(b) Dairy Type									
(c) Condition and Freedom from Disease	30	25	28	28	27	24	26	27	24
(d) Herd Sire: (i) Pure-bred ...	20	20	20	20	20	15	20	20	20
(ii) *Ex* tested Dam	10	10	10	10	10	...	10	10	10
4.—RETURNS PER ACRE— (120 points)									
(a) Butterfat (lbs. per acre) ...	100	53	72	66	48	64	100	21	20
Sidelines: Pigs, Poultry, Vegetables, etc., £..... per acre ...	20	20	9	4	6	14	3	2	2
5.—PIGS— (30 points)									
(a) Breed, Type, and Condition	10	9	7	4	5	7	8	5	7
(b) No. of Breeding Sows in proportion to Milch Cows ...	10	5	6	3	9	5	8	7	9
(c) Housing, Feeding, and Management	10	6	6	4	5	8	4	5	6
6. FARM MANAGEMENT (140 points)									
(a) Lay-out, Convenience, etc. ...	50	35	30	30	40	28	25	25	25
(b) Sanitation: (i) General	30	28	26	25	22	28	22	23	22
(ii) Milking Shed, Dairy, Dairy Utensils, and care of Cream and Milk	40	33	26	30	24	36	22	23	24
(c) Book-keeping and Records ...	20	17	18	13	15	17	15	15	16
7.—UTILISATION OF SKIM MILK (50 points.) Based on number of pigs reared and calf-months per cow ... (5 months—1 calf—1 pig)	50	48	48	24	11	32	10	25	14
Total	..	747	751	655	623	565	541	489	471
Handicap	...	..	15	10	...	...	...	...	...
Grand Total ...	1000	747	736	645	623	565	541	489	471

TABLE 5.

POINTS GAINED BY COMPETITORS IN ZONE 5.

Centre : Manjimup Agricultural Society. Judge : H. S. Rogers, Dairy Supervisor.

	Max. Points.	Points Allotted.																
		L. R. Barnsby.	T. N. Downes.	G. B. Omodei.	J. Daubney.	J. Bashford.	J. W. Pratt.	J. Flannagan.	G. Willis.	G. and T. Fletcher	N. South.	W. Grimshaw.	J. Moran.	A. Angel.	Thompson Bros.	E. W. Dewing.	R. Hall.	S. Gray.
1.—CONSERVATION OF FODDER AND SUMMER FODDER CROPS—(300 points)																		
(a) Hay : Quality, Condition ...	60	46	52	53	53	52	50	50	53	50	50	50	48	40	48	50	46	42
(b) Silage: Quality, Type, Wastage, etc.	60	52	57	56	55	94	58	47	58	54	56	49	52	48	49	54	...	...
(c) Summer Fodder Crops : Cultivation, Disease, Yield ...	50	44	45	35	40		43	35	42	25	38	...	45	...	...	...	30	35
(d) Amount conserved per cow	130	130	130	122	130	130	130	130	109	130	88	130	78	92	62	65	36	41
2.—PASTURES—(240 points)																		
(a) Condition, Freedom from Weeds, Mixture, Drought-resistance, etc.	150	120	117	125	118	130	112	112	120	118	112	115	120	120	118	112	108	120
(b) Management, Fertilisation	90	79	64	73	72	73	66	61	67	71	78	74	58	70	74	53	61	55
3. DAIRY HERD — (120 points)																		
(a) Breeding	60	51	49	53	53	49	44	48	44	39	42	42	46	51	33	45	47	46
(b) Dairy Type																		
(c) Condition and Freedom from Disease	30	23	23	25	26	25	23	22	25	21	21	25	22	25	22	25	23	23
(d) Herd Sire : (i) Pure-bred ...	20	18	18	19	14	10	17	17	13	19	18	18	18	18	18	17	19	18
(ii) Ex-tested Dam	10	8	7	9	...	...	...	7	..	9	9	...	...	...	...	...	7	8

4.—RETURNS PER ACRE—(120 points)																		
(a) Butterfat (lbs. per acre) ...	100	70	56	63	68	52	42	48	52	39	49	44	39	46	44	43	67	49
Sidelines: Pigs, Poultry, Vegetables, etc., £.....per acre	20	15	2	19	4	2	5	5	2	5	4	4	2	4	4	3	4	5
5.—PIGS—(30 points)																		
(a) Breed, Type, and Condition	10	9	8	9	9	7	9	9	8	8	9	9	8	9	8	8	8	8
(b) No. of Breeding Sows in proportion to Milch Cows ...	10	6	9	8	7	8	5	8	5	4	6	8	...	3	2	1	1	...
(c) Housing, Feeding, and Management	10	10	7	6	9	8	7	6	8	7	7	5	8	6	7	5	6	6
6. FARM MANAGEMENT—(140 points)																		
(a) Lay-out, Convenience, etc. ...	50	42	36	40	35	30	30	28	38	42	39	34	36	38	44	29	30	42
(b) Sanitation :																		
(i) General	30	25	27	21	26	22	23	24	25	24	25	23	24	18	26	24	22	21
(ii) Milking Shed, Dairy, Dairy Utensils, and care of Cream and Milk	40	34	37	30	36	31	31	31	33	32	32	34	34	23	34	29	31	27
(c) Book-keeping and Records ...	20	19	17	5	6	17	13	3	17	12	17	6	17	3	8	4	18	7
7.—UTILISATION OF SKIM MILK—(50 points)																		
Based on number of pigs reared and calf-months per cow ... (5 months—1 calf—1 pig)	50	46	25	15	29	25	29	42	12	12	10	34	25	30	17	23	19	15
Total	...	847	784	786	790	774	737	733	731	730	710	701	680	644	618	590	583	568
Handicap	...	15	...	...	10	...	...	...	...	...	...	...	...	...	...	...	...	...
Grand Total ...	1000	832	784	786	780	774	737	733	731	730	710	701	680	644	618	590	583	568

Zone 6.—Centre—Narrogin.

This zone (see map) embraces land lying on either side of the Great Southern Railway from Northam to Mt. Barker the rainfall varying from 17 to 33 inches in the extreme southern portion. Whilst primarily this area was considered essentially suitable for oats growing and sheep rearing, since 1932 the production of butter-fat has more than doubled, and the area now supports three butter factories, while a fourth at Albany draws the bulk of its supplies from this zone. Many farmers have now made dairy farming a permanent adjunct to their farming operations.

In this zone, pre-eminently, fodder conservation is the most important factor for success.

The special competition designed for this zone was therefore continued, judging being carried out according to the following scale of points:—

Fodder conserved per head of dairy cows	50 points
Hay—Quality and condition	50 points
Silage and/or Summer Fodder Crops	100 points
Use of Phosphatic Licks	25 points
Sanitation of Dairy Premises	25 points
Total	250 points

Details of the points gained by each competitor are shown in Table 6, winners in the competition last year being handicapped as follows:—

First prize winner—Deduct 5 points.

Second prize winner—Deduct 3 points.

Third prize winner—Deduct 1 point.

TABLE 6.

POINTS GAINED BY COMPETITORS IN ZONE 6.

Centre—Narrogin Agricultural Society. Judge: H. G. Elliott, Agricultural Adviser.

Competitor.	Handicap.	*Fodder Conserved per Head. (50)	Hay—Quality and Condition. (50)	Silage.	Summer Fodder Crops. (100)	Use of Phosphatic Lick. (25)	Sanitation of Dairy Premises. (25)	Total Points. (250)
T. A. Hardie ...	— 3	50	46	74		25	24	216
Mrs. M. A. McDougall	...	50	42	75		25	20	212
C. J. Comini ...	...	50	42	60		20	17	189

* Fodder conserved per head based on a conservation of 2½ tons of hay and 2 tons of silage or green material per cow.

Where both silage and fodder crops are provided, the scale of points to be halved in these sections, so that the total remains 100.

There were originally six competitors in this zone, but owing to the dry period experienced during early spring, those farmers realised that the quantity of fodder which had been conserved was inadequate, and therefore they withdrew from the competition.

It is now generally recognised in these drier areas that an adequate conservation of fodder is necessary, and during October it is becoming a common sight to see fields of "meadow hay" being cut, where several years ago reliance was placed solely on the oat crop to supply the hay requirements.

Table 7 shows the conservation by the three competitors in this zone, in comparison with competitors in the dairying districts. If a similar tonnage per cow could be conserved in these latter districts, it is confidently believed that the average production per cow would show a considerable rise.

TABLE 7.

FODDER RESERVES PER COW IN GREAT SOUTHERN DISTRICTS COMPARED WITH AVERAGE FOR SOUTH-WEST.

	Fodder Reserves per Cow.								Total Reserves calculated as Hay.			
	Hay.				Silage.							
	1935–6	1934–5	1933–4	1932–3	1935–6	1934–5	1933–4	1932–3	1935–6	1934–5	1933–4	1932–3
	tons.	tons.	tons.	tons.	tons.	tons.	tons.	tons.	tons.	tons.	tons.	tons.
Zone 6	6·03	4·45	4·9	2·9	...	3·25	2·8	3·3	6·03	5·53	5·83	4·0
Other Zones	1·30	1·43	1·49	1·21	0·55	0·84	0·89	1·16	1·48	1·72	1·79	1·60

None of the competitors in this zone, however, made any silage. It is unavoidable, when making considerable quantities of hay, to avoid deterioration in feeding quality, through a portion of the crop becoming too mature before being cut, or after cutting, remaining in the field too long before being carted.

This may be avoided by making silage of a portion of the crop which would normally be cut for hay.

Silage, however, has the additional quality of succulence, and therefore a special nutritional value during the dry summer months.

Mr. W. G. Burges, who has won this competition on three occasions, believes firmly that every farmer in the drier areas should have a store of silage, and himself makes at least 200 tons annually. During the present dry autumn this material has been of great value to early lambing ewes.

LESSONS FROM THE COMPETITION.

When the Better Dairying Competition was inaugurated in 1932, a five-year programme was planned by the local committee, the season 1935-36 being the final year in the series of competitions.

During the five years no less than 323 farms have been visited by the judges, and detailed information gathered regarding the farm operations. The judges wish to record their thanks to all competitors for the detailed information made available, often of a private nature, which has enabled accurate information to be made available on all the vital factors affecting success in dairy farming in Western Australia, and this information should be of great value to those wishing to embark on dairying, as a guide in estimating such factors as the value of land, its average carrying capacity, value of skim milk, revenue from pigs, fodder conservation necessary, etc.

1.—*Conservation of Fodder and Summer Crops.*

The object of the Federal Committee of the Australian Dairy Council in making sums of money available to each State, was to assist in the development of permanent pasture, but realising that in this State the area of land suited for permanent pasture in the true sense was restricted to areas in the extreme south or to the irrigation areas, the local committee decided to utilise such sums as were available in a competition to increase the amount of fodder conserved per cow. In this way only can the dry summer months be bridged with safety and profit. The goal was to induce all dairy farmers on unirrigated farms to conserve 2½ tons of hay or its equivalent per milch cow.

Economic handling of subterranean clover for the production of silage on Mr. W. J. Sears' property, Donnybrook.

Table 8 shows the average fodder conserved in each zone, and for comparison that conserved by the leading farmer.

TABLE 8.
TOTAL FODDER CONSERVED PER COW.

Zones.	Total Cows.	Hay.	Silage.	Reserve per cow		*Reserve per cow Calculated as Hay.
				Hay.	Silage.	
	1	2	3	4	5	6
1. Harvey	684	727	40	1·05	0·03	1·08
S. F. Russell ...	28	99	...	3·53	...	3·53
2.—Bunbury	564	562	46	1·00	0·08	1·02
L. Field	19	35	46	1·84	2·42	2·63
3.—Margaret River ...	199	425	360	2·14	1·81	2·74
A. Millar	33	50	40	1·51	1·21	1·91
4.—Bridgetown ...	256	425	154	1·66	0·60	1·86
A. Brazier	40	131	8	3·27	0·20	3·35
5.—Manjimup	406	572	569	1·41	1·40	1·88
L. R. Barnsby ...	20	36	39	1·80	1·95	2·45
Total, all Zones—1935-36	2,109	2,711	1,169	1·30	0·55	1·47
1934-35	1,550	2,232	1,307	1·43	0·84	1·72
1933-34	1,633	2,447	1,432	1·49	0·89	1·79
1932-33	1,531	1,854	1,784	1·21	1·16	1·60
1931-32	1,502	1,605	931	1·06	0·71	1·33
Average ... 1931-36	1,665	2,170	1,324·6	1·30	0·89	1·57

* 1 ton Hay = 3 ton Silage = 3 ton Fodder.

It will be seen from the above table that the fodder conserved per cow has shown a decided decrease during the year. This is accounted for by two facts—first, the great increase in the average size of herds, apparently in many instances to a point beyond the safe carrying capacity of the farm. This is in part due to the very low prices ruling for dairy cattle, and so farmers have kept cows in the herd which under normal conditions would be sold.

Secondly, it will be noted that while the total of silage and hay conserved is as great a tonnage as in any year, the decrease has been in the quantity of silage made. This was owing to the season, which was an unusually dry one during July and August, causing slow growth in annual pasture plants, notably subterranean clover. Farmers, therefore, feared that if this growth were cut for silage, there might be a poor, or possibly no, hay crop later in the season.

It is, however, difficult to understand why more silage is not made, as its advantages over hay for feeding to dairy stock are so generally recognised. The fact that one or two months abnormal weather can cause anxiety regarding the supply of fodder for stock in the South-West is indicative of the fact that farmers are inclined to sail too "close to the wind" as regards this particular item.

The competition has shown definitely that a far greater conservation of silage is desirable.

Silage cutting is performed before the regular hay season commences, and can be carried on almost regardless of the weather, as rain will not harm silage. By this means more of the annual pasture plants can be saved in the nutritious stage before maturity, while this is not possible where a large area has to be cut for hay, as the plants ripen very quickly once the warm weather has arrived. It is believed that silage making must eventually be routine practice on every dairy farm where irrigation water is not available.

Columns 4 and 5 show the quantity of hay conserved per cow is almost twice that of silage, and when one remembers that the dry matter in hay is approximately three times that of silage by weight, the quantity of silage becomes very small, only the equivalent of ¼ ton dry matter per cow, or the product of 1 16th acre of an average subterranean clover crop. The making of silage deserves the serious attention of every dairy farmer.

TABLE 11.

COMPARISON OF FODDER CONSERVED PER COW, 1931-32 TO 1935-36.

Zone.	Reserve per Cow.										Total Reserve, Calculated as Hay* (tons).				
	Hay (tons).					Silage (tons).									
	1935-36.	1934-35.	1933-34.	1932-33.	1931-32.	1935-36.	1934-35.	1933-34.	1932-33.	1931-32.	1935-36.	1934-35.	1933-34.	1932-33.	1931-32.
1. Harvey ...	1·06	0·66	1·23	0·92	0·76	0·06	0·23	0·51	1·00	0·24	1·08	0·73	1·40	1·25	0·84
2.—Bunbury ...	1·00	1·69	1·19	1·02	0·40	0·08	0·76	0·54	0·50	0·40	1·02	1·94	1·34	1·19	0·53
3. Margaret River ...	2·14	2·90	1·79	1·38	1·12	1·81	1·00	0·82	1·14	0·90	2·74	3·13	2·06	1·75	1·42
4. Bridgetown	1·66	1·36	1·60	0·94	1·23	0·60	1·47	0·80	0·81	0·75	1·86	1·85	1·87	1·25	1·48
5. Manjimup	1·41	1·60	2·10	1·58	1·53	1·40	1·13	2·10	2·29	0·71	1·88	2·00	2·80	2·37	1·76
7.—Denmark	...	1·53	1·20	2·11	1·62	...	2·08	1·20	2·20	0·71	...	2·23	1·60	2·66	1·86
Average all Zones ...	1·30	1·43	1·49	1·21	1·06	0·55	0·84	0·89	1·16	0·71	1·47	1·72	1·79	1·60	1·33

It will be seen from the above table that the total reserve of fodder, except in the case of No. 1 Zone (Harvey), which showed a 25 per cent. increase, showed a decrease compared with that of last year. This is accounted for purely by the seasonal conditions which particularly curtailed the making of silage.

It is interesting to note that apparently low conservation, even at the early date during the summer that judging took place, had an effect on the production of cows.

The Margaret River area (Zone 3) has again headed the zones for the production of fodder per cow, and leads easily in average butterfat production per cow, being no less than 260 lbs. per cow.

In the Bridgetown Zone the total of fodder conservation remained the same as last year, and here also production was well maintained, being the good average of 229 lbs. of butterfat per cow.

In Zone 1 (Harvey) there was a definite increase in fodder conserved per cow, and in addition, as 13 of the 19 farms examined were in irrigation areas, ample green summer fodder was also available. The cows in this zone produced the second highest quantity of butterfat per cow, namely, 233 lbs. per cow from 684 cows.

It is surprising that the making of silage from subterranean clover has not spread to a greater extent, particularly as throughout the heavy rainfall districts the procedure is so simple. The writer believes that on dairy farms silage is the first essential, and that hay should come second. Silage can perform all the functions of meadow hay, and in addition has the property of succulence which hay cannot possess.

Mr. J. Daubney, Manjimup, aims at conserving at least 2½ tons of fodder per cow, and accomplishes this by a combination of good quality hay, clover silage and maize crops.

2.—*Green Summer Fodder Crops.*

From what has already been said regarding the decreased quantity of fodder conserved per cow during 1935-36, it might reasonably be expected that there would be an increase in the area sown with summer fodder crops in an effort to compensate for the lesser fodder available for the lean months, particularly the low quantity of silage which normally would supply the succulent material during the summer.

The position is clearly shown in Table 12 below:—

Table 12.

ACREAGE OF GREEN FODDER PER COW.

Zone.	No. of Cows.	Summer Fodder Acres.	Acres sown per Cow.
1. Harvey	684	69	0·10
2. Bunbury	564	40	0·07
3. Margaret River	199	19·5	0·10
4. Bridgetown	256	4·75	0·02
5. Manjimup	406	35·3	0·09
Total, 1935–36	2,109	168·55	0·08

It will be noted that the area sown per cow is almost negligible, being only 0.08 acres per cow.

The fodder from this area, based on yields which in competitions and experiments, might be regarded as normal, namely, 10 tons per acre would only supply green material for one cow for a period of approximately 45 days, allowing for no wastage.

During the season just completed, even if the opinion held that summer crops are uneconomical be true, an increased area was justified to compensate for the poor harvest of silage.

Table 13 below, however, shows that even under this condition of low conservation of hay and silage, the area of summer fodders showed a considerable reduction on those for the previous year, and were the least of any year since the competition began.

Table 13.

AVERAGE AREA SOWN WITH SUMMER CROPS, 1931 TO 1936.

Zone.	1931–32.	1932–33.	1933–34.	1934–35.	1935–36.
1. Harvey	0·09	0·19	0·29	0·26	0·10
2. Bunbury	0·08	0·04	0·04	0·04	0·07
3. Margaret River	0·12	0·14	0·09	0·16	0·10
4. Bridgetown	0·14	0·02	0·001	0·07	0·02
5. Manjimup	0·13	0·14	0·130	0·11	0·09
6. Narrogin	...	1·56	1·00	1·00	1·84
7. Denmark	0·32	0·38	0·550	0·35	...
Total	0·14	0·127	0·141	0·17	0·10

In the above table it is significant that those districts in which the area of green fodders are greatest are those outside the Dairy Belt proper, and in which butterfat production is not the main source of revenue.

The reason for this has been elucidated by an examination of the records of cows tested under the Grade Herd Recording Scheme. During the last two years the records of cows have been divided into groups according to the month in which lactation commenced, and it has been found that the period of year in which calving takes place does definitely affect the subsequent production during that lactation period.

These investigations have shown that cows calving after July may suffer a handicap of 15 per cent. to 20 per cent. of their capacity to produce if they had calved during April to June.

In dairying districts, therefore, farmers are endeavouring to mate their cows so as to calve during these early autumn months, and in those cases where cows calve "out of season," rather than grow small areas of fodder crops to maintain production during the summer months such cows are allowed to "dry off" with the rest of the herd so that they may calve in the most profitable season the following year.

Apart from this consideration, however, another reason for the unpopularity of these summer crops seems to be the general impression that heavy applications of expensive fertilisers are necessary to ensure success.

It is not uncommon to find such crops as maize sown with expensive fertiliser mixtures, with dressings per acre ranging from 4 to 8 cwt. Maize variety trials and fertiliser trials carried out by the Department of Agriculture over a number of years indicate that such dressings are uneconomical, and that where heavy yields have been so obtained the cost is excessive. The most economical dressing for such summer crops is 3 cwt. of superphosphate-and-ammonia No. 3 per acre. For those desirous of mixing their own fertilisers, this fertiliser consists of superphosphate, 2½ parts, and sulphate of ammonia, 1 part.

Rotational Sowing of Maize for Summer Fodder on Mr. S. F. Russell's Farm, Serpentine. Winner in Zone 1 (Harvey).

The varying success obtained in the growing of summer crops undoubtedly is due to lack of thorough cultivation of the soil, and, where farmers feel they are unable to give the land the cultivation thought necessary, they would be well advised to desist wasting money on seed and expensive fertilisers—this latter necessity, however, is rather a reflection on capacity for crop husbandry.

One of the special needs for dairy stock during the summer months is an adequate supply of protein nutrients obtainable usually as clover hay or clover silage, the latter for preference. Very promising results have been obtained during the last three years from the growing of cow peas (*Vigna sinensis*) and it is believed that this crop will prove a valuable means of supplementing silage as a source of protein during the summer months.

Failures with cow peas which have been reported have been due generally to two factors:—

(a) The sowing of the seed, especially on "new" soil, without first inoculating the seed with the special strain of soil bacteria necessary for the healthy growth of this particular legume. Cultures of these bacteria may be obtained from the Department of Agriculture, the cost being 1s. 6d. per tube, post free.

(b) The sowing of the seeds too early in the season, before the soil is sufficiently warm. Although numerous summer growing leguminous crops have been experimented with in this State from time to time, so far the cow pea offers the brightest prospects.

3.—*Pasture.*

During the last five years there has been a remarkable awakening by farmers throughout the whole State, but in particular among dairy farmers, as regards the true value of pasture, whether this be of the true perennial type or composed of annual plants.

In the non-irrigation areas reliance has of necessity to be placed on annual plants, but by management and the incorporation of certain perennial grasses where suitable it is being found possible to considerably lengthen the period during which green fodder is available. Such practices are:—

(a) The harrowing of annual pastures at least once during the year. As this harrowing is primarily to loosen the surface soil and provide a semblance of a seed bed and also to spread "droppings," it must be performed before the seeds have all germinated, but after the "droppings" have been softened by rain. The most profitable harrowing is therefore that during early autumn, after a good soaking rain.

(b) Early application of superphosphate, if possible prior to harrowing. It is now generally recognised that at least one cwt. of superphosphate per acre is desirable, and heavier dressings are profitable. Where only one cwt. is to be applied, this should be applied in one dressing during early autumn. Where two cwt. is to be applied, the second hundredweight can with profit be applied together with a second harrowing during August or September, according to the district.

(c) The addition of blade grasses, with a longer growing period than subterranean clover. No perennial grass has yet given sufficiently satisfactory results to warrant general advice as to its adoption for improving swards of annual clovers. Phalaris tuberosa has succeeded in certain districts, on fertile soils, but the results have been disappointing in many areas, and further information is required before this grass can be recommended in a mixture to be used on a dairy farm.

The annual grasses—Wimmera rye grass and Italian rye grass—on the other hand have proved very effective for incorporating with a subterranean clover pasture, as they can be sown at the time of the annual harrowing in autumn, and will reseed sufficiently to reproduce themselves the following year. These grasses will remain green longer than the clover, and by providing a mixture, assist in preventing the pasture causing "clover-taint" in milk and cream.

Pasture in Irrigation Areas.

It is in these areas that one finds an intense interest among farmers for any matter connected with the development of permanent pasture. The present competition, combined with demonstrations in rotational grazing, in the value of small paddocks, in different systems of sowing the seed, and in preparing the ground, together with the astonishing success of some of these trials, has been responsible in a great measure for this spirit of inquiry found throughout the irrigation areas.

Certain definite advice can now be given as a result of these trials conducted over the last three or four years, which may be briefly summarised as follows:—

(a) A fertile soil is necessary for success, and therefore land intended for permanent pasture should carry a crop of subterranean clover for several years before permanent pasture seeds are sown.

A crop of potatoes has been found an excellent precursor to permanent pasture.

(b) Thorough preparation of the soil is essential. Methods quite successful for sowing crops like subterranean clover are worse than useless for permanent pasture seeds, as they will undoubtedly lead to the loss of those expensive seeds.

(c) Variety trials have shown to date that the following mixture will be generally satisfactory:—

Certified perennial rye grass—4 lbs. per acre.
Paspalum dilatatum—8 lbs. per acre.
Certified white clover—2 lbs. per acre.

(d) The time of sowing is governed by several considerations.

Unless sowing is completed early in the autumn while the ground is warm, poor germination of paspalum will result owing to the rotting of the seed during winter months.

Autumn sowing is also dangerous if the land previously was infested with lucerne flea (*Smynthurus viridis*), or in particular the "red mite," which will almost certainly attack the white clover plants as they germinate and kill them.

Early autumn planting on well prepared ground is recommended; if this is not possible, planting should be delayed till the spring, and then not later than October.

J. P. Norton, Capel. Cows grazing on water couch pasture, providing excellent succulent fodder during the summer.

(e) The land should be rolled after the seeds have been sown. No other cover is necessary if the seed bed has been well prepared.

(f) Seed should be sown with 2 cwts. per acre of "Super. and Ammonia No. 3"; but subsequent applications of manure should be of superphosphate only, as once established, the white clover will provide the nitrogen required by the grasses.

(g) Care should be exercised during "stocking" to prevent the young pasture being over-grazed, a guide being to remove the stock when the bare ground becomes visible between the plants.

4.—Dairy Herd Management and Butterfat Production.

The number of cows embraced in the competition this year was the greatest since the beginning of the competition in 1931-32, and the average production is also the highest yet recorded, namely 212 lbs. of butterfat.

The average production each year since 1931-32 is shown in Table 14 below.

TABLE 14.

AVERAGE PRODUCTION PER COW, 1932–1936.

Season.	No. of Cows.	Butter Fat per Cow. lbs.
1932–33	1,531	201·5
1933–34	1,632	208·8
1934–35	1,550	192·7
1935–36	2,109	212·0
Average 1932–36	1,706	205·9

While this high average production is gratifying, it must be borne in mind that the cows producing this yield are those owned by the leading farmers in each zone, and while the general district average may be lower, it is confidently expected that, if the methods of those farmers are studied as outlined in this report, and adapted to suit their special requirements, it will not be long before the average of all cows in dairying districts will exceed this figure. Whereas only six herds in 1932 produced more than 250 lbs. of butterfat per cow, 18 herds exceeded this figure in 1933-34, while last year 20 herds reached this high standard.

It is interesting to note that of these 20 herds no less than 17 are being tested under the Grade Herd Recording Scheme. The names of the owners of these herds are shown in Table 15 below.

TABLE 15.

HERDS PRODUCING MORE THAN 250LBS. BUTTERFAT PER COW, 1935-36.

Owner.	No. of Cows in Herd.	Production of Butterfat per Cow.
G. E. Scott, Yarloop	26	355·0
N. Ranson, Rosa Brook	15	337·3
C. Peterson, Wokalup	30	320·0
A. Millar, Forest Grove	33	313·1
A. Tomerini, Balingup	27	301·5
W. Shaw, Harvey	53	298·0
S. C. Maidment, Balingup	26	295·0
S. F. Russell, Serpentine	28	290·0
J. Oldfield, Forest Grove	20	289·6
L. Field, Donnybrook	19	273·0
A. C. Frost, Donnybrook	16	270·0
Ellis Bros., Brunswick	37	266·0
J. Angel, Rosa Brook	20	264·4
J. Daubney, Northcliffe	19	260·0
Norton Bros., Capel	79	258·0
A. R. Testar, Cookernup	24	255·0
A. Wright, Balingup	28	253·3
G. B. Omodei, Eastbrook	20	253·0
L. Temple, Harvey	30	250·5
E. L. Marsden, Cookernup	27	250·0
Total, 20 Herds	577	5552·7
Average	28·85	274·44

The average herd owned by these 20 farmers comprises 29 cows, with an average production of 274.4 lbs. of butterfat per cow.

The steady increase in production of cows throughout the South-Western districts is reflected in the steady increase in production of cows owned by competitors. One of the means by which this is being obtained is by improving the quality of dairy stock through the use of pure bred bulls, and as heifers bred as a result of this policy come into production, a greatly increased average production can be expected. Practically all competitors own pure bred bulls, and all judges remark that there is a distinct improvement in the average type of cows in the herds during the last five years. This is not, of course, a result of the Better Dairying Competition, but is an indication of the general uplift which is taking place throughout the dairying districts in Western Australia with a view to reducing the cost of production of butterfat to as low a figure as possible.

It will be seen in Table 16 that the three breeds recommended by the Department of Agriculture, and the studs of which have been entered by their owners in the Pure Breeds Herd Recording Scheme, comprise 93.6 per cent. of the dairy bulls in use by competitors, the three breeds being the Jersey, Australian Illawarra Shorthorn and the Guernsey.

TABLE 16.

PERCENTAGE OF BULLS IN USE ACCORDING TO BREED.

Breed.	1932–33.	1933–34.	1934–35.	1935–36.
	%	%	%	%
Jersey	66·0	57·5	57·5	43·5
Guernsey	18·0	17·5	25·4	33·9
A.I.S.	11·0	15·0	15·9	16·2
Ayrshire	5·0	5·0	1·6	1·6
Friesian	...	5·0	...	3·2
Red Poll	...	...	...	1·6
Total	100·0	100·0	100·0	100·0

In view of the increased number of "250-lb. herds," it is a matter of interest to compare the average production of each zone with that of the herd producing the highest yield in the same zone. This will be an indication that failure to produce cannot be placed against the particular district or locality, but on one or more factors directly under the control of the farmer. There is no insurmountable reason therefore why all herds should not show a considerable increase in production in the future.

This comparison is shown in Table 17 below.

TABLE 17.

AVERAGE PRODUCTION PER COW IN EACH ZONE, TOGETHER WITH THAT OF THE HIGHEST PRODUCING HERD.

Zone.	Number of Cows. No.	Average Cows in in Herd.	Average Butterfat per Cow. lb.
1. Harvey	684	36·0	233·4
G. E. Scott, Yarloop	...	26·0	355·0
2. Bunbury	564	56·4	205·0
L. Field, Donnybrook	...	19·0	273·0
3. Margaret River	199	22·1	260·0
N. Ranson, Rosa Brook	...	15·0	337·3
4. Bridgetown	256	32·0	229·1
A. Tomerini, Balingup	...	27·0	301·5
5. Manjimup	406	23·9	179·6
J. Daubney, Northcliffe	...	19·0	260·0
Average, all Zones	...	33·5	212·0

It will be noted that except in the case of the Manjimup Zone, the average production of herds examined varies from 205 lbs. to 260 lbs. butterfat per cow.

An examination of records of production in Grade Herd Recording Schemes shows that it is extremely difficult to maintain the production of a grade herd above 250 lbs. butterfat per cow. The average in the Bunbury Zone last year was 230 lbs. per cow, but with less than half the number of cows in the competition.

This deduction is borne out further by the fact that, generally, the high producing herds are composed of cows which are either pure-bred and registered, or that have been bred along definite lines for so many generations that they may be regarded as "genetically" pure-bred, although unregistered in a stud book.

Such herds would be those owned by G. E. Scott, Yarloop, whose herd of registered Guernsey cows showed the highest average production in Zone 1 and also in the Pure Breeds Herd Recording Scheme last year. Mr. L. Field's herd, at Donnybrook, which averaged 273 lbs. butterfat is also a pure-bred herd of Jerseys. Mr. N. Ranson, at Rosa Brook, and Mr. A. Tomerini, at Balingup, are to be congratulated on the high production of their herds, composed of good type grade Jersey cows. It will be interesting to see whether this high average can be maintained in the future, which result will depend entirely on the selection of a pure-bred bull, bred from a cow with a higher butterfat production than the herd average, and *prepotent* for that high production. Such animals are difficult to purchase.

A herd deserving mention is that of Mr. W. Shaw, at Harvey. This herd of 53 grade milking Shorthorn cows averaged 298 lbs. of butterfat entirely off grass. On this farm it is necessary to keep production constant during the year, the above result showing the possibilities of irrigated permanent pasture.

The average production of cows in the Manjimup Zone is disappointing, the chief factor being insufficient conservation of fodder.

Where ample fodder reserves are provided, high productions have been obtained, as in the case of the late Mr. H. C. Barnsby's herd, at Pemberton, which produced over 250 lbs. butterfat per cow and was the highest producing herd in the district each year.

This year Mr. Daubney, at Northcliffe, whose herd of 19 cows averaged 260 lbs. of butterfat per cow, has again shown that ample fodder reserves are essential for high production.

5.—*Butterfat Per Acre.*

While the average production per cow must be known in order to determine whether any particular animal is returning a profit over cost of feed, it is essential to have some information regarding yield per acre before an estimate can be made of the value of the land embraced in the farm.

Table 18 below gives this information for each zone, and also the highest production per acre in each zone for a comparison.

TABLE 18.

AVERAGE PRODUCTION OF BUTTERFAT PER ACRE IN EACH ZONE COMPARED WITH THAT ON THE LEADING FARM.

Zone.	Acres Devoted to Dairying per Farm.	Average No. Cows per Herd.	Butterfat per Acre.				
			1935–36.	1934–35.	1933–34.	1932–33.	1931–32.
1. Harvey ...	172·0	36·0	48·9	47·0	61·6	34·8	53·4
S. F. Russell	120·0	28·0	67·7	...	...	...	...
2. Bunbury ...	213·0	56·4	54·1	57·7	32·8	46·6	50·4
L. Field ...	81·0	19·0	64·1	...	...	...	...
3. Margaret River	100·3	22·1	57·3	54·9	46·6	43·6	37·9
A. Millar ...	150·0	33·0	69·0	...	...	...	...
4. Bridgetown	154·0	32·0	56·0	42·9	35·7	40·7	35·1
A. Brazier ...	170·0	40·0	53·8	...	...	...	...
5. Manjimup ...	86·3	23·9	49·7	49·0	46·0	38·8	35·5
L. R. Barnsby	68·0	20·0	70·0	...	...	...	...
7. Denmark ...	...	...	...	58·1	70·0	49·4	45·4
Average all Zones	144·1	33·5	50·3	48·6	43·8	42·6	43·0
Average 6 Leading Farms ...	118·0	28·0	63·76	72·8	48·6	54·0	49·0

The information contained in Table 18 is most informative to any person considering purchasing a farm to be developed for dairying.

It will be seen that during the first three years of the competition the production per acre was practically constant at 43 lbs. of butterfat; during the last two years there has been a continued rise, in 1935 of 5 lbs. per acre, and in 1936 of a further 2 lbs. per acre, the acreage production being 50.3 lbs. per acre. The possibilities are shown by the individual productions given, and by the average from the six leading farms of nearly 64 lbs. butterfat per acre.

This increase in production per acre is particularly valuable, as it has not been obtained by reducing the size of herds and milking only the higher quality cows. Each year since the inauguration of the competition the average herd has increased in size as is seen by reference to Table 19. In 1931 the average herd was 24 cows, while in 1936 this had grown to 34 cows, being an increase of 42 per cent. during the 5 years.

The relatively low production in the No. 1 Zone (Harvey) needs mention. The majority of the farms in this zone are irrigated, and while individual productions are high the average is less than that of all farms, and considerably less than those in the Margaret River, Bridgetown, and Bunbury Zones.

During 1934 Mr. W. Shaw, Harvey, produced 82 lbs. of butterfat per acre; this year Mr. S. F. Russell, Serpentine, produced 68 lbs., and in 1931 Miss C. Heppingstone, Harvey, produced 148 lbs. of butterfat per acre.

The production figure this year is not a true indication of the value of irrigated pasture, but rather a suggestion that the best returns are not being obtained on the average irrigated farm. Reviewing the results of the competition during the last five years, it appears that the butterfat produced per acre on irrigated farms should be twice that produced per acre on "dry" farms.

An examination of the yields from individual farms brings out the fact that where the average production per acre is unusually high, it is on those farms which are below the average in area.

Probably these small farms are now fully stocked and are returning their maximum production under better than average management conditions. Under such conditions a figure of 70 lbs. of butterfat per acre is possible, and was for several years and still is being obtained on the farm of the late Mr. Barnsby, where 20 cows are being maintained on an area of 68 acres of unirrigated land.

It is desirable, however, to be able to expand and such areas are considered too small in "dry" districts, the average area for all zones, i.e., 145 acres being desirable, or as mentioned in previous reports, a minimum of 120 acres of cultivable land which, with good management, will support a herd of 30 milch cows.

6.—*Areas utilised per Milking Cow.*

In ascertaining the number of acres necessary to support a milking cow, provision must be made for the attendant heifers, and dairy sire, also horses. It is estimated that a farm supporting 20 milking cows, or a 20-cow unit farm, will comprise 50 stock as set out below. In this estimate allowance is made for 10 per cent. losses in all young stock, which is a liberal allowance.

Stock on Farm Supporting 20 *Milking Cows.*

20	Cows.
9	Heifers 2 years old.
9	Heifers—Yearling.
9	Heifer Calves.
1	Bull.
2	Horses.
Total 50	

Table 19 shows the number of acres utilised per milking cow for each year that the competition has been in operation.

Table 19.

ACRES UTILISED PER MILCH COW.

Zone.	Average No. of Cows in Herd.					Acres Devoted to Dairying.					Acres per Cow.				
	1935-36.	1934-35	1933-34.	1932-33.	1931-32.	1935-36.	1934-35.	1933-34.	1932-33.	1931-32.	1935-36.	1934-35.	1933-34.	1932-33.	1931-32.
1	36·0	41·0	35·7	31·7	31·7	172·0	189·0	123·8	150·7	138·9	4·7	4·46	3·6	4·8	4·4
2	56·4	29·5	36·0	42·2	43·5	213·0	117·6	244·7	207·5	247·7	3·8	3·80	6·8	4·6	5·1
3	22·1	23·1	21·3	20·6	19·0	100·3	93·5	91·0	88·8	81·5	4·5	4·00	5·8	4·3	4·3
4	32·0	21·9	25·6	23·3	17·6	154·0	125·0	134·4	117·4	96·1	4·8	5·40	5·3	4·4	5·5
5	23·9	21·5	21·8	23·2	17·1	86·3	77·4	85·3	118·1	92·4	3·6	3·60	4·2	5·1	5·7
7	...	20·2	18·5	19·0	13·7	...	89·2	55·0	85·1	57·4	...	4·40	3·0	4·5	4·2
Average ...	33·5	27·7	26·3	25·5	23·7	144·1	118·6	126·7	120·6	119·0	4·3	4·14	4·7	4·7	4·9

It will be seen that in 1931 those farms entered in the competition required 4.9 acres to support each milch cow, this number being reduced slightly each year to 4.14 acres in 1935. As was pointed out last year, however, it was believed that this low figure was attained through conditions of overstocking in the No. 5 Zone (Manjimup) and would probably not be maintained. These conditions still continued in this zone during the period covered by the competition, though it has been considerably relieved since.

In Zone 1 during 1934 and 1935 conditions of over-stocking prevailed, but this was remedied during 1935-36.

During the 1936 competition the average carrying capacity of dairy farms inspected was one milch cow to 4.3 acres. This may seem a low carrying capacity, but taking into account the other stock on a dairy farm associated with a milking cow as detailed above, namely heifers, calves, bull and horses, the actual carrying capacity of such a farm on a per capita basis is one beast to each 1.7 acres.

It will be seen from Table 19 that the size of herds has increased annually from 24 cows in 1931 to 34 cows in 1936. Until herds attained a strength of 28 cows, there was practically no development of new land beyond 120 acres.

This is further evidence that approximately 30 cows is the maximum that can be carried with average management on 120 acres of unirrigated land.

Another point is that until a farmer is milking 28-30 cows he has little funds to employ the extra labour required for clearing operations. The most difficult period, therefore, in the development of a dairy farm is from the 15 to the 28 cow carrying capacity, as herds over 15 and under 28 require a man's whole time to manage, and yet do not leave time to develop new country on any large scale. Once the higher number of cows is attained, development can be more rapid as additional labour may be employed.

In estimating carrying capacity from the above returns, it would be well to bear in mind that the farms represented in the competition are among the better managed farms in each district, and that whereas these farmers are maintaining a milch cow on 4¼ acres, a figure of 4½ acres would be a fair average on which to base estimates.

7.—*Pigs.*

During the 1935 competition the judges reported that there was evidence that dairy farmers were again taking an interest in the possibilities of pig raising, as an adjunct to the production of butter fat.

During the first three years of the competition the number of breeding sows decreased each year, mainly owing to the low prices being realised for pork products; but this of itself should not require the quitting of breeding sows, which cost practically nothing to maintain on a dairy farm.

The tendency to restock with pigs noted during 1935 has continued during the present year, though there is a long way to traverse before the 1931-32 total is reached.

The position regarding the number of cows to each breeding sow is clearly shown in Table 20.

TABLE 20.

COMPARISON OF NUMBER OF COWS TO BREEDING SOWS.

	No. Cows.	No. Sows.	No. of Cows to 1 Sow.		
			1935-36.	1934-35.	1933-34.
Zone 1—Harvey	684	30	22·8	23·6	34·5
„ 2—Bunbury	564	48	11·7	10·2	10·7
„ 3—Margaret River	199	32	6·2	6·9	15·9
„ 4—Bridgetown	256	37	8·6	10·9	11·2
„ 5—Manjimup	406	41	9·7	11·6	10·6
„ 7—Dermark	...	...	...	8·4	12·3
All Zones—1935-36	2,109	188	11·2	...	...
1934-35	1,550	124	12·5	...	...
1933-34	1,633	115	14·2	...	...
1932-33	1,531	144	10·7	...	...
1931-32	*950	141	6·7	...	...
Average all years—1931-1936 ...	1,554·6	142·4	10·9	...	...

* Whole milk suppliers excluded.

Table 20 shows that in No. 1 Zone (Harvey) the number of pigs on dairy farms is very low. This is to be expected as the majority of farmers in this zone are suppliers of whole milk to the metropolitan area, but it will be noted that the increase over the number of pigs in this area in 1934 has been maintained during the past season.

In No. 2 Zone (Bunbury) it is difficult to understand why a greater number of breeding sows than one to eleven milch cows is not being kept, particularly as these farms are well developed and supplying butter factories, and would therefore have large quantities of skim milk available.

In the Margaret River and Bridgetown Districts considerable interest is being shown in pig raising, and a gross revenue of as high as £3 per cow has been obtained.

It is estimated that the gross revenue from pigs should average at least £2 per cow, although this figure has been rather bettered by the farmers in the competition. The average number of pigs handled on each farm was 38. Some of these would have been sold as porkers and some as baconers. Accepting an average valuation as 40s. each, the gross revenue from pigs would average £76 per farm of 33 cows or the equivalent of £2 6s. 0d. per milch cow. On dairy farms where ample green material and skim milk are available, the expenses in rearing pigs should be low, the greater portion of this £2 6s. 0d. being profit.

Even in districts such as Margaret River there is still room, however, for expansion along the lines of pig raising until the number of sows carried is one per 5 milch cows.

Table 21 below shows the breeds of sows owned by competitors.

TABLE 21.

BREEDS OF SOWS OWNED BY COMPETITORS.

Breed.	No. of Sows.				Percentage.			
	1935–36.	1934–35.	1933–34.	1932–33.	1935–36.	1934–35.	1933–34.	1932–33.
Berkshire	26	26	35	70	14	21	30	49
B. x T.	120	75	61	55	64	61	53	38
M. White	9	3	1	6	5	2	1	4
M. W. x B.	10	2	2	4	5	2	2	3
L. White	4	9	6	2	2	7	5	1
Other Breeds ...	19	9	10	7	10	7	9	5
Total ...	188	124	115	144	100	100	100	100

It will be seen that Tamworth x Berkshire sow is gaining in popularity each year, at the expense mainly of the pure Berkshire sow. It is believed that the pure Berkshire sow will become popular again now that a strain has been developed—popularly called the Canadian Berkshire—which yields carcases suitable for either the local or export bacon trades.

The Department of Agriculture in 1930 strongly advised farmers to carry only the Tamworth and Berkshire breeds, as it was believed from the experience which could be gathered from leading breeders and curers throughout the State that these two breeds would supply the carcases required for pork and bacon both locally and overseas, and, moreover, were particularly suited to West Australian farming and climatic conditions. It will be seen that last year 82 per cent. of the breeding sows owned by farmers were of those two breeds.

The results of the Perpetual Trustees' Export Trophy for bacon and pork pigs during the last two years show that the Department's recommendation in 1930 was justified, as pigs bred from the Tamworth and Berkshire on the average gained the highest points from local judges and also from Smithfield experts who submitted a report from England on the carcases.

These results have been confirmed still further by a series of trials on Mr. W. G. Burges' "Tipperary" property at York, in which the Tamworth crossed with the Canadian Berkshire have yielded carcases suitable for the export market and classed "A" grade by those competent to judge.

Sows grazing on clover at Sabina Vale Stud Farm, Wonnerup. Under these conditions, the cost of keeping sows is very small, and they should not be sold during periods of low prices for bacon.

8.—*Cost of Fertilisers.*

Owing to the almost universal absence of available phosphoric acid in West Australian soils, farmers now make it a routine practice to apply dressings of a phosphatic fertiliser, generally superphosphate, to all crops, including pasture land, each year. It is valuable, therefore, in endeavouring to arrive at the cost of producing dairy produce that some reliable figure for the average expenditure on such fertiliser should be available. This information is given for each zone in Table 22.

TABLE 22.

QUANTITY AND COST OF FERTILISER FOR PRODUCTION OF BUTTER FAT.

Zone.	Pounds of Fertiliser used per lb. of Butter Fat Produced.		Average Superphosphate Applied. (lbs. per acre)		Total Expenditure for Fertiliser per Acre.		Cost of Fertiliser per lb. of Butter Fat.	
	1935-36.	1934-35.	1935-36.	1934-35.	1935-36.	1934-35	1935-36.	1934-35.
					s.	s.	d.	d.
1.—Harvey ...	3·76	4·15	184	195	6·133	7·394	1·504	1·888
2.—Bunbury ...	2·90	3·60	154	169	5·133	6·408	1·160	1·638
3.—Margaret River ...	3·74	3·90	214	221	7·133	8·342	1·496	1·774
4.—Bridgetown	2·83	3·40	132	123	4·40	4·659	1·132	1·547
5.—Manjimup ...	3·24	3·10	161	153	5·366	5·801	1·396	1·410
7.—Denmark ...	...	4·90	...	259	...	9·858	...	2·229
Averge all Zones	3·72lbs.	3·7lbs.	161 3lbs.	179·8lbs.	5·37s.	6·66s.	1.488d.	1·683d.

Superphosphate, 1935-36, £3 15s. 0d. per ton; 1934-35, £4 5s. 0d. per ton.

The figures for fertilisers used on dairy farms have only been obtained during the last two years, but already several important deductions can be made from Table 22.

1. Although the price of superphosphate was reduced in 1935-36 by 10s. per ton in comparison with the price for the previous year, the quantity of fertiliser used per acre showed a slight decrease. As the majority of the competitors had been in the competition previously, this result is rather disquieting. The quantity per acre decreased from 180 lbs. to 161 lbs.

2. The district using the heaviest applications per acre, namely, Margaret River, shows easily the highest butter fat production per cow, and this same fact is even more marked in the case of individual herds. With the subdivision of large paddocks into smaller fields and the development of rotational grazing, it will be found that heavier annual applications of superphosphate are justified. In the dairying districts where all the fodder required by the herd is grown on the farm the cost of fertiliser would be the largest item in the cost of feed, and this only amounts to a maximum of 1.50d. per lb. of butter fat, and may be as low as 1.13d. per lb. Heavier applications therefore can be justified without fear of increasing the cost of production.

In calculating the cost of fertiliser no allowance has been made for freight from works to farm.

SUMMARY.

1. Interest in permanent pasture production has increased during the year, particularly in the irrigation areas.

2. On dry areas the grazing period may be lengthened by the incorporation of grasses with a longer growing period than subterranean clover, such as Italian rye grass, Phalaris tuberosa, and Wimmera rye grass.

3. In irrigation areas, on "new" land, paspalum and white clover are recommended. On special fertile land perennial rye grass and white clover have given good results.

4. The importance of the conservation of fodder cannot be over-stressed, and more fodder should be conserved, particularly in irrigation areas, where conservation should be in the form of hay.

5. On "dry" farms increased conservation of silage is strongly recommended, as there was a serious decrease during last season.

6. The average conservation in all zones is 1.64 tons of hay per cow, which is approximately the same as for the previous two years. The goal of 2½ tons of hay per milch cow is still considered as desirable.

7. Summer fodder crops are distinctly out of favour with dairy farmers for several reasons mentioned in the text.

8. The average production of the 2,109 cows in the competition was 212 lb. butter fat. As these cows have been maintained on farms considered to be above the average for the dairying districts, the estimated production of the average cow in the South-Western portion of the State is believed to be approximately 180 lb. butterfat per lactation period.

9. Twenty herds produced more than 250 lb. butterfat per cow, compared with six herds in 1932-33.

10. The production of butter fat per acre increased by approximately 6.74 lb. per acre over that of previous years, being 50.34 lb. per acre. This figure, however, is probably slightly inflated to what may be looked for on the average dairy farm, by reason of the fact that a number of farms in Zone 5 were small in area and probably fully stocked.

The average figure of 43 lb. butter fat per acre for the first three years is probably near the general average.

11. The average herd in the competition has increased to approximately 34 cows, which has maintained the tendency shown each year for herds to become larger. This increase in the size of herd, however, to be on sound lines, must be accompanied by an increase in the area devoted to dairying.

12. The average dairy farm inspected comprised 144 acres, which is a big increase in area for farms entered in the competition in 1933-34, but still indicates that 100 to 120 acres should be the minimum for an economic dairy farm.

13. The area required to carry a milking cow is 4.3 acres, compared with 4.7 for the three previous years.

As mentioned above, and during the course of the above report, it is believed that certain areas are overstocked to the detriment of production and that 4.5 acres is probably a correct average figure for the area required to maintain a cow. This, of course, is for "dry" farms.

14. During the year there has been an endeavour to increase the avenues of revenue on the dairy farm. Care should be taken that these avenues are not increased at the expense of legitimate butter fat production. Avenues such as egg production, potato-growing, and vegetable-growing are limited in scope and should not be so developed as to interfere with butter fat and pig production.

15. As pointed out in 1934, pig-raising had fallen to a dangerously low ebb, and even breeding sows had been disposed of throughout dairying areas. There is a tendency now for pig-raising to be increased and the number of breeding sows has been increased from 1 sow to 14 cows to 1 sow to 12 cows. It is believed that 1 sow to 5 cows will prove profitable.

16. The use of phosphatic licks is general throughout the summer months, while in the Northcliffe and Denmark areas a phosphatic lick which also contains limonite (oxide of iron) has given remarkably good results.

17. By reason of the very comprehensive information which is required by the judges, whereas during the first competition great difficulty was obtained in securing information owing to the general absence of any system of records on farms, it is pleasing to record that, not only amongst competitors but amongst dairy farmers generally, a more or less complete record of the operations of the farm is now being kept.

GRASSHOPPER WARNING.

L. J. NEWMAN,
Government Entomologist.

During the spring of 1935, August to October, inclusive, a very widespread plague of this insect occurred in the north-eastern and eastern agricultural areas, with lesser outbreaks as far south as Bruce Rock, Narembeen and South Kumminin districts.

The fact that the crops in most parts of these areas failed through lack of sufficient rain to mature them offset the damage that would have followed had such a plague occurred when crops and pastures were good. As it was, the grass and stunted crops were cleared up by the hoppers, thus accentuating the shortage of food for stock. Owing to a late good spring rain in the Bruce Rock, Narembeen and South Kumminin infested areas, the crops revived and resulted in fair returns. This made the presence of the grasshoppers in these districts a more seri-

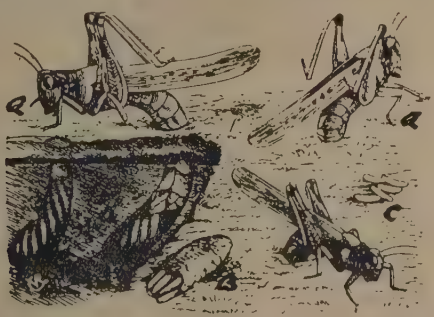
ous matter. Fortunately, the farmers, by good co-operative work, were able to prevent serious loss of these crops. Poison bait was supplied free, the farmers providing the labour for distribution. The unfortunate position now is that the swarms of grasshoppers present last spring have left myriads of eggs in the soil. The present season, owing to the belated and light autumn rains, is all in favour of a big percentage hatching of eggs during the coming spring; this will be particularly so if the winter should again be a comparatively dry one.

The eggs hatch out normally about the last week in July and onwards to the end of August, the main swarm issuing during the first week in August. The position is yearly becoming more serious, as properties not being worked are increasingly becoming breeding centres for this very destructive pest.

To get at the root of this trouble, some method must be adopted whereby cleared country can be again brought under cultivation. If this is not done, we shall be more and more subject to plague swarms of grasshoppers should the meteorological and other factors be favourable. In a recent survey in late May of the grasshopper area, the eggs in the soil were found to be in a healthy state. This indicates that if the meteorological and other factors continue favourable to the hatching of the eggs, a serious potential plague threatens us this coming spring.

Preventive Measures.

All known egg-infested land should be broken up as soon as possible after egg laying takes place, in October and November. The land must be ploughed and worked down to a fine tilth. It is of little use simply ploughing the land into a rough lumpy condition as myriads of the grasshopper egg pods will remain uninjured and unexposed in the clods and will eventually hatch. By thoroughly



Female grasshopper in act of laying. *a, a, a*, female in different positions, ovipositing; *b*, egg-pod extracted from ground, with the end broken open; *c*, a few eggs lying loose on the ground; *d, e*, show the earth partially removed to illustrate an egg mass already in place and one being placed; f shows where such a mass has been covered up. (After Riley.)

working the soil these egg pods are broken and the eggs exposed to the weather and various predatory parasites. It is admitted that many egg-laying grounds become too hard to work in November. If this is found to be the case, advantage must be taken of the first autumn rains to work the land. Land thoroughly worked as suggested will not prove suitable for grasshopper egg laying the following spring.

In view of the very serious probability that we shall experience a plague outbreak of grasshoppers next July and August, it behoves all farmers and others interested to keep a careful watch for the first appearance of the pest and at once notify the district officers of the Agricultural Bank or the Department of Agri-

culture. Unfortunately in the past most farmers have shown little interest in the matter until their crops are being invaded. Usually it is then too late effectively to deal with the trouble, as most of the hoppers have reached the adult winged

Adult or full-grown Grasshopper. [Original.]

stage and have become widespread. The cost of treatment when this stage is reached is greatly increased, owing to the enormous amount of poison bait required due to the larger area to be treated.

Pre-winged hopper stage.
[Original.]

It is, therefore, of the greatest importance that the poison baiting be undertaken whilst the grasshoppers are in the pre-winged or hopper stage. If this very important rule is not observed, economic control is impossible.

Poison Baiting.

This is the only proved economical method, under our conditions, of dealing with grasshoppers once the eggs have hatched. In the use of poison bait, it is of the greatest importance to see that it is mixed to a moist crumbling mash. If made

too wet it will form into layers. In its distribution, every care must be taken to see that it is scattered in small particles. This can best be done by scattering it against whatever wind is blowing.

When thrown about carelessly in lumps as was done last year in some areas serious results to stock or sheep are sure to follow.

It must be definitely understood that just so long as these lumps of poison bait remain, they are a potential danger, as the arsenic content does not readily deteriorate. Losses of stock occurred last year due entirely to lumpy distribution of poison bait.

Poison Bait Formula.

Bran 30 lbs., arsenite of soda ¾ lb., molasses 4 lbs., water 2¾ gallons. *Modus operandi*: The arsenite of soda is dissolved in ¾ gallon of boiling water and then added to the balance of water, making 2¾ gallons of poison solution. The 4 lbs. of molasses is then dissolved in the poison solution. When completely dissolved, mix with the bran until sufficient has been added to make a moist crumbly mash. If made too wet it is difficult, in fact, impossible, to scatter it finely. The mixing should be done on a floor, a cement base, or a large sheet of flat iron. All utensils used in the preparation of the poison bait should be thoroughly cleaned. Keep the hands out when mixing and when distributing rub them well with some grease or vaseline. Do not use more than 30 lbs. per acre.

The bait, to obtain the maximum results, should be distributed on a bright, still, sunny morning, between the hours of 8.30 a.m. and 10 a.m. Scatter it finely amongst the hoppers and a few yards ahead of the advancing swarm. Do not bait on a dull, cold or wet morning as the hoppers are inactive and not feeding. Grasshoppers are day feeders and hence are hungry in the morning and when warmed up by the sun, readily take the bait. An inspection of the baited area should be made three days later and, if necessary, more bait distributed. Keep all stock off the baited areas for several days.

Any successful campaign against grasshoppers must of necessity be co-operative, all farmers in any infested area working together and mutually assisting one another.

A BIRD IN THE HAND IS WORTH TWO ON THE PERCH.

Culling for the Beginner.

G. D. SHAW,
Poultry Adviser.

(Published by courtesy of the Australian Broadcasting Commission, being based on a broadcast address given through Station 6WF.)

We have reached that stage in the poultry industry where almost all distress amongst poultry farmers can be brought home to either one of two causes: lack of capital and or bad management. Generally, the two are combined, for lack of capital means that the person embarking on poultry farming with little cash is one who does not understand that poultry farming is a business and an exacting business at that. With those who had sufficient capital in the first place any distress can, in 95 per cent. of cases, be laid at the door of mismanagement. It is not suggested that in either case it is wilful mismanagement due to laziness, for in-

stance, or a "don't-care" attitude. It is due to not understanding the relationship to the job in hand and, of all the exacting studies in poultry farming, breeding and rearing are about the most important.

In breeding it is now generally accepted that "like breeds like" and in believing that one must take extreme care to ensure that the parents of the future generation of poultry are such as will produce the characteristics so desired by the successful breeder—type, stamina, size and the faculty of high production.

If "like breeds like" we can then understand that our breeders this year must have stamina, size and be producers of large eggs. There has been a bad habit throughout the industry of mating any bird which lays an egg.

For those who do not use trap nests or single pens, resort must be had to knowledge of the strain, careful study of the type, and lastly, but not the least important, handling.

A bird in the hand is worth more than two on the perch. Handling is the main method of selecting breeders. Too many men and women do not practise any method of selection; any old hen, any old cockerel. No wonder we hear complaints from the industry. The silent poultry farmers are generally the workers and thinkers. They are never heard. Their job is too engrossing to be bothered about the other type. Everyone of those silent, thinking workers believe in type, stamina and production and do the selection on the handling basis.

Years ago an American named Hogan invented (I use the word with restraint) a system called the Hogan system which guaranteed the selection of high producers, by handling the birds and working to a mathematical system of measurements. Do not believe that the system was any good. It was not, except when used by Hogan alone. He understood the characteristics of the birds he was handling and so could apply his system efficiently. When handling the breeder we cannot depend on measurements. Measurements are only a confirmation of what has already been assumed after studying the bird's type, head, eye, feathers, contours, legs and walk, but it is essential to handle the birds in order to confirm our opinions.

So now we must learn to handle and in conjunction with type, head, eye, etc., we can, with a high degree of accuracy, place our birds into one of the three categories so often found on a poultry farm. These are: the waster who never will nor can lay an egg; the sprinter who lays all her eggs in the spring and loafs on us the other nine months of the year: and lastly, the profitable producer which is being overworked in order not only to feed the waster and the sprinter, but who must have then sufficient energy to feed the owner. It will be noticed that the waster and the sprinter always happen to be fed before the owner gets his share; so the owner growls, and growls loudly. The poultry farmer who handles and eliminates the waster and the sprinter from his stock does not have to wait for his feed so he is not a growler and we never hear from him.

Now you will realise that the bird in the hand is worth two on the perch.

Catch the bird by the thigh, not by the wings—that hurts. Hold it in the left hand, legs through the fingers, body along the palm of the hand, head pointing toward the elbow. That doesn't hurt and the bird is contented and restful.

We will use a white leghorn as a demonstration.

By now passing the right hand down from the neck of the fowl to its tail and by keeping the forefinger and thumb under the wing when doing so, one should desire a bird which has a width nearly equal to the diameter of the ordinary household flour sieve. While so doing one also gauges the distance between the two

palms and that depth should also equal the width so that the barrel of a well-proportioned bird is just about equal in diameter to the flour sieve. From the neck to the tail should be one and a half times the width.

That is a clear idea of the size of a well-proportioned white leghorn hen. Heavy breeds are bigger by about one and a half fingers; all measurements. The waster will be small across the back, shallow in depth and short of body. Instead of the barrel being even depth along through, you will find that the breastbone is not parallel to the back, but distinctly slopes upwards, so much so that at times it nearly touches the backbone at the stern. No width, no depth, no capacity, and, on looking at the head, eye and type, a small head, small eye and a distinct departure from type will be found, but easiest of all will be your notice of the comb. The comb of a waster will be small, thin, especially thin and dry to the feel, with no blood inside, a sort of leathery feel, and it will be covered with a whitish powdery colour effect.

The sprinter will show perhaps type, good eye and an indifferent sized head. The handling will show, may be, fair width, good depth at front, shallow at rear but not as bad as the waster. Rather a hard type for the beginner to practise on. It takes confidence to weed out this type. She looks so like a layer—is laying—but, and here is the catch, when you know the idea you will find that she does lay, but only one egg per week and one egg doesn't pay. Out her. The comb characteristic of this class of bird is rather disconcerting. It is full to touch, may be large or small, but it doesn't shrivel up until she has stopped short after her sprint lay. It will then dry up and if you see any dried combs before February, handle the bird and see if she has not been a sprinter which has been missed. You will find she has.

Now for the producer—the one which is to go into the breeding pen at the correct time. Full back, full depth, long from neck to stern, and showing good capacity, stamina and vitality she should be a good producer—she generally is. She has a good head, eye and comb; always looks, no matter whether in the moult or not, as if it is made of flesh. It is strong and pulpy, always shows colour and is of fine velvet to the touch. A good bird—plenty of these are seen on good poultry farms.

Now for the cockerel. He may be bred by the farmer or he may be purchased. Nevertheless the characteristics are the same: type, head, eye, handles well and is the son of a good producer. Departmental files are full of letters of inquiry asking where cockerels can be obtained, somewhere about 5s. each—do not want the best, only to mate up with some old hens. No wonder we are in trouble. I am afraid it will be thus for ever. Five shillings for a bird which is to head a breeding pen of 10 good well handling hens! Only 5s., not enough to pay for his feed up to the breeding time—not enough to even pay for attention and housing! Only 5s., an insult to the person breeding when 5s. is expected to cover feed, kerosene and now for big letters—BRAINS!

Our sheep men will pay big money for the head of their flock; our poultry men want the head for 5s. Do you know that to be able to sell a reasonably good male bird, a breeder must have fed at least another 12 to 15 birds for 12 months before he can select the one. It costs 8s. alone to feed the bird, and as only one or two are any good, he sells the market the remainder at 3s. 6d. to 6s. per pair, and yet we want that bird for 5s. I will not send any purchaser to any breeder unless he is prepared to pay 20s. to 30s. for a cockerel and any purchased cheaper are only the culls, wasters, anything you like to call them, but don't call them breeders, unless you mean breeders of tragedy.

Having bought a good bird do not sell him when the season is finished. Keep him and his mates for next year and still keep on keeping them until they die of old age. Never dispose of your breeders unless you are sure of replacing them with younger birds equally as good and never lose sight of them within the flock: have them marked so that if the daughters are high producers keep on using the originals to produce more high producers.

"A bird in the hand is worth two on the perch." We must all learn to handle and the sooner a start is made the better; to-night for preference. It is quite easy to clear out the waster. It is quite easy to mark the sprinter and watch it closely, and you will have no trouble in finding good breeders from the big handling, good, clean-faced birds. Always remember that the comb and the ova are closely related. Full-blooded comb means large ova and plenty of eggs. Hard, leathery comb means small shrivelled ova—nothing at all. Unfortunately we have too many birds with nothing at all inside.

Handle the birds as often as possible. Go round the sheds at night with a lamp and handle them. It is easy to catch them after a night or two, so easy to learn and compare and so easy to attain proficiency and then ease and comfort on the farm.

Make it a practice to go out for one night per week and examine and handle the birds. Until we do, we will be keeping fowls instead of the fowls keeping us.

CASTRATION EXPERIMENT.

A COMPARISON OF THE "BURDIZZO" AND KNIFE METHODS.

F. L. SHIER and N. DAVENPORT.

It has been frequently stated that the best prices obtained for lambs exported from this State to the United Kingdom are from those which have been shipped early in our season. The price returns from previous seasons have clearly demonstrated this statement. Western Australia has a decided advantage over the Eastern States, both on account of the earliness of its season and its closer proximity to the British market.

By early mating and the production of ample supplies of good early green feed lamb producers have endeavoured to produce good quality lambs in the shortest time possible. However, any practice which would still further lessen the period of maturity is well worthy of consideration. Advocates of the "Burdizzo" method of desexing lambs have frequently claimed quite an appreciable reduction in this time, as compared with the knife method, which is in general use in this State. With the "Burdizzo" method the spermatic cord is crushed and severed by means of powerful blunt pincers, but without any external wound. The testes do not develop and thus fail to function for reproductive purposes. The effect is thus the same as if they had been completely removed.

Dr. A. H. H. Fraser, of the Duthie Experimental Stock Farm, Rowett Institute, Aberdeen (1), using ten pairs of half-bred male lambs, one twin being castrated by the "Burdizzo" method and its brother with the knife, showed that the bloodlessly castrated lambs made more rapid gains between castration and weaning, the average increase being 59 lb. as against an average of 53 lb. for those cut with the knife. Although these results are highly significant, the conditions under

which the experiment was conducted are hardly comparable with those in this State, particularly with the occurrence of twin lambs. For this reason it was considered desirable to carry out an experiment to determine whether any advantage would be gained by the adoption of the "Burdizzo" method of castration under local conditions.

AVONDALE EXPERIMENTS, 1935.

These were designed to compare the "Burdizzo" and knife methods of castration of lambs with respect to the following considerations:—

1. Mortality.
2. Rate of maturity.
3. Quality of the carcases.

Besides comparing the castrating knife v. "Burdizzo" pincers, the factor of sex with respect to its relation to the rate of maturity was also studied.

It is well known that in Western Australia where prime quality export lambs are generally produced by the double cross (Longwool-Merino half-bred mother with Southdown sire), considerable variation occurs among the individual progeny. For this reason it was essential to have the results from a large number of lambs, in order that sufficient data would be available from which a reliable conclusion could be drawn. It was decided, therefore, to use the progeny of 499 Border Leicester-Merino half-bred ewes mated with Southdown rams which were available at the Avondale Research Station.

Three times a week all the lambs which had been born were weighed and eartagged. The eartags of the ewe lambs bore the prefix letter E in addition to the distinguishing number. The eartag of each alternate male lamb bore the prefix letter B and the remainder the letter K. After eartagging, the lambs and their mothers were drafted into another paddock where a crop of rape and oats was growing. Owing to the large flock involved a few of the lambs became separated from their mothers during this process. Consequently a number of deaths occurred (see Table 1). At intervals of one week all lambs sufficiently large and strong enough were earmarked and tailed in the usual way. At the same time the male lambs bearing the prefix letter B on the eartags were castrated with the "Burdizzo" pincers and those with the letter K with the knife.

Table 1.

	Number Tagged.	Number Marked.	No. died after marking.	Number remaining on farm.	Number slaughtered.
Ewes	219	208	4	8	196
"Burdizzo"	109	104	2	2	100
Knife	109	105	2	...	103

Those lambs which had reached a suitable weight (approximately 65 lb. or more), and had attained satisfactory conformation and "finish" were forwarded periodically to the abattoirs for slaughter and grading. Several lambs which were not sufficiently well grown at the time of the last consignment remained on the farm (see Table 1).

In all, six consignments went forward, the first killing occurring on 20th August and the last on 19th November. The details of these consignments are shown in Table 2.

TABLE 2.

	Date Slaughtered.	Ewes.	"Burdizzo."	Knife.	Total.
1	20th August	22	24	22	68
2	10th September	31	21	15	67
3	24th September	57	19	31	107
4	1st October	24	15	8	47
5	22nd October	38	16	18	72
6	19th November	24	5	9	38
	Total 6 shipments ...	196	100	103	399

RESULTS AND DISCUSSION OF THE EXPERIMENT.

Mortality.—The advocates of the "Burdizzo" method claim that there is less likelihood of losses through infection by its use, as compared with the knife. The losses after marking in the different groups can be seen from Table 1. Two lambs were lost from both the "Burdizzo" and knife groups and four from the Ewe group. These losses are quite small and may be expected under the most careful conditions. No large losses should occur by using the knife method where reasonable aseptic precautions are taken. This view is supported by general experience.

Rate of Maturity.—The experiment was so carried out that a complete history of each lamb was obtained from birth to the grading of the carcase.

Table 3 shows the number of lambs marketed, the mean birth weights, pre-slaughter weights, age at slaughter, and carcase weights for each group, together with the range of the figures from which each mean was obtained.

TABLE 3.

	Ewes.	"Burdizzo."	Knife.
Number of lambs marketed	196	100	103
Mean Birth Weight (lbs.)	8·7	9·4	9·2
Range	(6–12)	(7–12)	(7–12)
Mean age at slaughter (days)	137·5	126·7	130·4
Range	(94–202)	(86–196)	(96–194)
Mean pre-slaughter weight (lbs.)	69·9	70·8	70·6
Range	(61–82)	(63–80)	(61–81)
Mean Carcase Weight (lbs.)	32·3	32·5	32·6
Range	(26–41)	(26–42)	(25–41)

While it is seen that the preslaughter and carcase weights are similar, the "Burdizzo" group reached a marketable size 3.7 days sooner than the knife group. Statistical treatment of these results shows that this difference is not significant.

Garner & Sanders (2) in a similar experiment conducted at the University Farm, Cambridge, comparing the two methods of castration, found no difference in the subsequent growth rates.

Quality of the Carcases.—After slaughter at the abattoirs, the lambs were graded for export in the usual way by the grader of the West Australian Meat Exports Company. The results of this grading are shown in Table 4, as percentages of the various grades in descending order of quality.

Table 4.

Section.	Grading. Swandown.	Blue Gum (Cross).	Blue Gum (Ordinary).	Red Gum.	White Gum.	Reject.
	per cent.	per cent.	per cent.	per cent.	per cent.	per cent.
Ewes ...	10·0	54·0	20·5	12·0	3·0	0·5
"Burdizzo"	5·0	45·0	26·0	20·0	4·0	*Nil*
Knife ...	10·5	54·5	18·5	14·5	3·0	*Nil*

An examination of the above table shows that while the carcases of the ewe and knife groups were very similar, those of the "Burdizzo" group graded somewhat lower.

It is felt, however, that the quality of the "Burdizzo" lambs was quite comparable with that of the other groups and that the lower grading of their carcases may be explained at least in part by the influence of outside factors, such as bruising in transit and occasional bad dressing.

Sex.—Hammond (3) states that about a month after castration the effect of the operation has worn off. The wethers then put on weight more quickly than the ewes. At eighteen weeks he found the weight ratio of the wether to be 106.7 per cent. of that of the ewe. These findings are fully supported by the Avondale experiments.

Table 3 shows that the ewe lambs took an average of 137.5 days to reach an average of 69.9 lb. live weight, while the "Burdizzo" treated lambs took 126.7 days to reach on average of 70.8 lb. The corresponding figures for the knife group were 130.4 days and 70.6 lb.

Objection to the "Burdizzo" Method.

Considerable criticism has been levelled at this method owing to its element of uncertainty. Imperfect or careless manipulation of the instrument may easily result in one or both cords being either incompletely crushed or missed altogether. It has been stated that in such cases the animals subsequently develop coarser carcases. However when lambs are marketed as suckers these characteristics would be developed to such a slight extent that they would hardly be discernible in the carcase. This was borne out in this experiment in several instances where it was obvious that the operation had been only partially successful. Careful examination of such carcases at the abattoirs failed to reveal any differences from other carcases of the "Burdizzo" or knife groups.

The possibility previously mentioned of an imperfect operation by the "Burdizzo" method has, however, one definite disadvantage in practice. This is due to the fact that certain lambs which fail to develop sufficiently may remain on the farm after the export season closes. It is hardly necessary to emphasise the potential danger should such lambs remain with the flock.

SUMMARY AND CONCLUSIONS.

A description has been given of an experiment conducted at the Avondale Research Station to compare the "Burdizzo" and knife methods for the castration of lambs.

The experiment indicated that there was no difference between these methods in mortality, and subsequent growth rate of the lambs.

There was an apparent difference in carcase quality in favour of the knife treated group.

It was found also that the ewe lambs took an average of nine days longer than the wether lambs to reach similar preslaughter or carcase weights.

Where the "Burdizzo" method was only partially successful there was no loss in carcase quality of such lambs marketed as suckers.

REFERENCES.

1. Fraser, A. H. H., *Scot. Journ. Agric.* 16, 86 (1933).

2. Garner & Sanders, *Journ. Agric. Sc.* 26, 296 (1936).

3. Hammond, J., *Growth and Development of Mutton Qualities in the Sheep* (1932), p. 22.

METEOROLOGICAL INFORMATION.

STATIONS.	TEMPERATURE.				RAINFALL.		TEMPERATURE.				RAINFALL.		TEMPERATURE.				RAINFALL.	
	Maximum.		Minimum.		For Month.	Average.	Maximum.		Minimum.		For Month.	Average.	Maximum.		Minimum.		For Month.	Average.
	Mean.	Highest.	Mean.	Lowest.			Mean.	Highest	Mean.	Lowest.			Mean.	Highest.	Mean.	Lowest.		
	MARCH, 1936.						APRIL, 1936.						MAY, 1936.					
					inches.	inches.					inches.	inches.					inches.	inches.
Chapman State Farm	93·7	103·1	64·6	58·6	*Nil*	·78	85·8	102·6	58·8	50·5	1·13	·62	73·9	89·3	49·4	37·4	1·49	2·46
Geraldton	84·7	101·4	67·2	61·0	·02	·58	81·6	102·8	59·8	48·8	1·21	·85	72·7	86·6	55·3	42·8	1·49	2·78
Walebing	90·7	102·6	62·3	53·8	·70	·84	79·8	97·1	54·8	44·5	·32	·84	69·3	85·2	44·5	33·6	4·19	2·63
Perth	84·9	102·1	64·0	54·0	·21	·84	77·1	93·2	57·6	46·8	·59	1·69	68·1	83·2	51·7	37·8	5·43	5·10
Kalamunda	84·7	98·0	61·0	50·4	·29	1·05	76·3	93·0	61·1	48·0	1·18	1·99	66·3	81·2	55·2	39·2	5·99	6·24
Bunbury	80·3	94·6	58·7	48·8	·25	1·00	73·7	91·0	52·8	43·2	1·40	1·69	65·9	73·0	49·2	35·3	3·59	5·20
Bridgetown	85·5	100·0	51·0	38·8	·08	1·07	76·5	92·0	45·0	37·0	·96	1·69	65·1	75·0	41·2	29·8	3·12	4·61
Albany	72·8	92·8	59·5	49·6	·29	1·61	71·0	92·1	54·6	47·6	1·15	2·80	63·8	76·2	50·9	40·6	4·12	4·98
Merredin State Farm	90·4	99·5	62·1	53·8	·60	1·00	79·0	91·5	52·9	40·0	·10	·94	68·7	85·0	44·5	33·0	0·71	1·32
Northam	91·5	103·4	61·9	53·4	·26	·85	79·7	94·4	52·4	43·0	·27	·85	69·1	85·4	44·9	35·8	1·83	2·31
York	89·9	101·0	60·2	53·5	·10	·76	78 7	96·0	50·4	41·0	·39	·86	68·1	84·0	45·1	35·0	1·93	2·39
Narrogin State Farm	87·7	98·5	55·3	43·9	·21	·79	75·2	94·5	49·4	38·1	1·43	1·19	64·3	80·5	44·6	34·2	4·44	2·95
Katanning	84·5	98·8	55·9	44·8	·33	1·02	74·0	90·6	49·7	41·7	1·49	1·18	62·9	77·0	44·7	35·0	1·99	2·42
Cape Leeuwin ...	72·3	78·0	62·2	57·2	·19	1·21	69·9	90·0	58·8	54·2	1·08	2·25	63·2	71·5	55·6	47·8	4·97	5·90

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